

ARCHIVES OF OTOTOLOGY.

ON THE POSSIBILITY OF DETERMINING SOME
IMPORTANT TOPOGRAPHICAL RELATIONS IN
THE TEMPORAL BONE FROM THE FORM OF
THE SKULL.

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(With plate II.)

SOON after Schwartze's introductory papers on the mastoid antrum and its operative opening, Hartmann¹ and Bezold² minutely examined the anatomy of the entire region, and gave us new information concerning the so-called "dangerous" temporal bones. And by this phrase we mean those temporal bones in which the sigmoid fossa of the transverse sinus protrudes so far forward into the base of the pyramid and mastoid process, and in which at the same time the floor of the middle cranial fossa lies so low that the antrum cannot be opened without endangering the dura mater of the cerebral lobe and the transverse sinus.

Amongst the many authors who have referred to these dangers, Politzer³ speaks in the most decided fashion:

"Another point which we have to consider before performing the operation, is the impossibility of deciding in any patient whether the mastoid process is pneumatic, diploetic, or solid, and whether in the given case the base of the skull or sigmoid fossa are anomalous or not. These things we can only learn as the operation proceeds, and this

¹ Langenbeck's *Archiv*, Band xxi.; and *Bericht ueber den 3ten internat. Otologen-Congress*, Basel, 1885.

² *Monats. f. Ohrenhklde.*, Band vii., No. 2, and Band viii., Nos. 1 and 2.

³ *Lehrbuch*, p. 641.

is why we can so rarely decide beforehand whether the operation will or will not be successful."

This also is one of the reasons why so many different methods of performing the operation are from time to time suggested.

Thus, Hartmann says that we should invariably begin the opening as if we were sure of finding a "dangerous" temporal bone, whilst Schwartze brushes aside so strict a formula, and suggests (perhaps in reference to Hartmann's and Bezzold's opinions) that the dangers of the field of operation have been greatly exaggerated.

In the midst of such confusion, therefore, we are urged to ask the important question: *Is there then no way in which we can foretell whether any given temporal bone is or is not likely to be a dangerous one?*

An off-hand comparison (without any measurements) of dolichocephalous and brachycephalous skulls shows that in the former the lateral walls are almost perpendicular to the base (Fig. 1, A), so that the distance between the outside of the mastoid processes is about the same as that between the parietal tuberosities, whilst in the brachycephalous skull the mastoid processes are not so far apart as the parietal protuberances, for the very simple reason that here the lateral walls converge from above downward (Fig. 1, B). The angle formed by the upper side of the pyramid and the squamous portion of the temporal bone resp. the lateral wall of the skull is in each case nearly a right angle. From this we see, then, that this side of the pyramid is almost horizontal in dolichocephalous skulls, whilst in the other variety of skulls it ascends sharply from without inward. And, finally, the inner and outer districts of the floor of the middle cranial fossa are about on the same level in dolichocephalous skulls, whilst in the brachycephalous skull the outer portion of the fossa is much deeper.

These variations in the topography of the temporal bone were so plain that I was led to investigate the question: *whether the exact situation of the floor of the middle cranial fossa and the course of the transverse sinus in the temporal bone in any way depended upon the form of the skull.*

My examinations were made on one hundred and twenty temporal bones from the skulls of thirty-eight different races, and twenty-two that were exclusively German, all sawn through the sagittal median plane.

Particular attention was given to skulls of different races in order that all variations might be compared, and the laws of formation, if any such existed, might the more easily be discovered. As was to have been foreseen, the rules discovered in these skulls were also available in those of German origin.

The investigations that I have lately made have convinced me that various measurements easy to be obtained give us such sufficient information in regard to the form of the skull as to enable us to decide upon important anatomical relations in and about the temporal bone. If we measure with calipers the distance between the bridge of the nose and the most prominent point of the occiput (which, by the way, does not always correspond to the external occipital protuberance), and then the distance between the parietal protuberances, and, finally, if we divide the last measurement into the first, we obtain a number, which, for the sake of brevity, I will call the index. This index varies in my collection of skulls between 1.55 (dolichocephalous) and 1.07 (brachycephalous). The slight variations which arise in the living, from including the thickness of the scalp in the measurements, may safely be neglected. The only occasional difficulty during the measurements is that the parietal protuberances are absent in pronounced dolichocephalous skulls, so that really the most prominent points of the lateral walls are no further apart than the mastoid processes. How then in such cases shall we measure the breadth of the skull? The superior and posterior angle of the origin of the temporal muscle should be regarded as the same as the parietal protuberances. In bare skulls we should start from the linea semi-circularis, which forms the above-mentioned limit of the temporal muscle, whilst in the living we can easily feel the expansion of the muscle by causing the patient to execute the motions of chewing.

I will now append the indices of the various skulls:

Index.	No.	Race.	Index.	No.	Race.
I.55	1	Shangalla negro.	I.29	3	Chinese, Russian, German.
I.52	2	Ashantee, Australian.			Chinese.
I.49	1	Gaika-Kaffir.	I.27	1	German, Russian.
I.45	1	Negro.	I.26	2	Russian, 2 German.
I.44	3	Negroes.	I.25	3	2 Russian, 2 German.
I.43	1	Australian.	I.24	4	German.
I.42	1	Ashantee.	I.23	1	Russian, German.
I.41	1	New Caledonian.	I.22	2	Russian, German.
I.40	3	Ethiopian, Australian. Greenlander.	I.21	1	Russian.
I.39	1	German.	I.20	2	Javanese, German.
I.37	2	German, Ashantee.	I.18	1	Russian.
I.34	4	Chinese, Papua, 2 Australian.	I.17	3	Javanese, German, Russian.
I.33	1	Anamite.	I.16	2	Peruvian, German.
I.32	4	2 German, Russian, Chinese.	I.15	1	German.
I.31	3	2 German, Chinese.	I.13	1	
			I.12	1	
			I.07	1	Goway-Indian.

In order to compare the varying situation of the floor of the middle cranial fossa and the transverse sinus, we must invariably refer to unalterable points upon the skull. And these points are :

(1) *The most anterior portion of the linea temporalis*, which is, however, not very serviceable on account of its many variations.

(2) *The upper end of the porus acusticus externus*; and

(3) *The spina supra meatum*, which is a small bony prominence at the posterior and superior margin of the porus, the end of a small ridge which splits off from the linea temporalis above the external meatus, and stretches off in the rear. The spina is rarely absent, but it varies in form, sometimes being a point, sometimes a notch, or occasionally a small bony comb. Its position is also occasionally occupied by a little pit, which, nevertheless, is of as much aid in orientation as the spina itself.

If, now, we wish to draw from these external marks any conclusions in regard to the floor of the middle cranial fossa, we must first establish the location of the boundary line between the floor itself and the lateral wall of the fossa; and this can be done with the aid of the ortho-pantograph, or with a pair of caliber compasses.

The results of my measurements in this respect are contained in the following table *in millimetres*:

Index of Skull.	1.55—1.40	1.39—1.30	1.29—1.20	1.19—1.07
The floor of the middle cranial fossa lies above the porus acust. externus.	average . highest . lowest .	11.5 17. 7.	5.8 15. 4.	5.1 9. 2.
The floor of the middle cranial fossa lies above the spina supra meatum.	average . highest . lowest .	15.3 17. 10.	12.1 17. 7.	7.6 12. 5.
				4.8 5.8 4.
				7. 9.

The table shows us that the floor of the middle cranial fossa in dolichocephalous skulls lies higher above the porus acusticus externus and the spina supra meatum than in brachycephalous skulls.

If, then, we know the index of any given skull, the table will assist us greatly in determining the location of the floor of the middle cranial fossa.

It is also well worth observing that the average measurements, as well as the maxima and minima, are all greater with higher indices than with the lower.

The application of all these facts in operations upon patients is hindered by the concealed position of the external starting-points. We can, indeed, easily discover with the sound or the tip of the little finger the upper edge of the porus from the meatus externus, but in order to reach the spina supra meatum, we must freely loosen the auricle from its attachments and bend it forward. The following method may also prove of some assistance: If we imagine a straight line projected through the outer and lower angle of the bony orbit and the upper margin of the porus, the floor of the middle cranial fossa, at least in the mastoid region, will be found to lie as high above this line as above the porus itself.

If we have a well-pronounced dolichocephalous skull, the linea temporalis may, under certain circumstances, pass through the field of operation (Fig. 1, A). In such a case we should utilize the space above, as much as possible, in order to obtain a large orifice for the operation, and a good view into the bottom of the cavity.

The operation is much more difficult in well-marked brachycephalous skulls, because when the petrous bone rises higher as we proceed inward, and the middle cranial fossa is deep, we are sure to find that the antrum, too, lies high (Fig. 1, B). We must therefore chisel obliquely, because the summit of our excavation ought not to lie any higher than the upper part of its external margin.

All that we have so far shown goes to prove that it is desirable in every operation on the mastoid process to begin as far forward as possible.

After we have learned how to avoid the middle cranial fossa, the "dangerous" temporal bone offers a new risk; the *transverse sinus* occasionally advances so far forward and outward into the mastoid process that it may in some cases absolutely prohibit the operation (Fig. 2). But we cannot precisely state the frequency of these cases, because the danger of the sinus is a relative idea. A skilful operator may proceed without risk, where the unskilful one will open the sinus. I have in one hundred and twenty temporal bones found but three in two skulls in which it would have been impossible to avoid injuring the sinus.

The more or less dangerous sinus is rarely seen, except with a deep middle cranial fossa, *i. e.*, in brachycephalous skulls. Bezold observed the same coincidence; and for this reason I have endeavored to ascertain to what extent the danger of the transverse sinus depends upon the form of the skull.

Index.	1.55—1.50	1.49—1.40	1.39—1.30	1.29—1.20	1.19—1.07
Right	average . . .	7.83	8.22	6.00	5.05
	maximum . . .	9.00	15.00	14.00	7.50
	minimum . . .	7.00	4.00	3.00	2.00
Left	average . . .	10.00	9.72	7.86	7.34
	maximum . . .	11.00	12.00	15.00	11.00
	minimum . . .	9.00	7.00	5.50	1.75
Average difference between right and left in favor of left	2.17	1.50	1.86	2.29	1.28
Total average for both sides	8.91	8.97	6.93	6.19	4.86

My measurements show that the sinus lies farther outward in brachycephalous skulls than in the dolichocephalous, and that (independent of the form of the skull) it lies farther outward on the RIGHT side than on the LEFT.

The table shows in *mm* the thickness of the bony wall of the sulcus transversus at its thinnest spot within the mastoid region.

The walls were equally thick on both sides in 10%, thicker on the right side in 77%, and thicker on the left side in 13%.

All of the skulls apparently confirmed the assertions of Hartmann and Bezold, that the deeper the sinus penetrates into the mastoid, the further in front it lies.

In regard now to the influence of the form of the skull upon the "danger" of the transverse sinus, we can certainly affirm that in the brachycephalous skull the sinus on both sides extends farther forward and outward into the mastoid process than in the dolichocephalous. But we must expressly emphasize that the "danger" is not proportional to the degree of brachycephalicity, because the two skulls that I observed with the most dangerous transverse sinuses had indices of but 1.22 and 1.26 respectively; or in other words, they were distinctly but not extremely brachycephalic.

I would therefore propose the following rule for avoiding the sinus in operations on the mastoid process:

The smaller the index the farther forward the opening should be made; if the patient is an adult, with an index of 1.30 or less, we ought to operate, if possible, in front of the auricular attachment, particularly if the right antrum is the one involved.

I have so far spoken only of the dangerous situation of the sinus in adults, for this condition is not found in the immature, but is only first observed during the growth of the skull. The average distance of the sigmoid fossa of the sinus from the meatus is in young children not only relatively, but absolutely, greater than in adults (Hartmann).

With the form of the skull, however, there is this difference, that it is congenital, as has been satisfactorily and

finally determined by Lucae's measurements, extending over long series of years.¹

We are therefore next inclined to ask what it is during the growth of the skull that makes this sinus in the brachycephalous more dangerous than in the dolichocephalous.

Bezold and Ruedinger suspect that the greater supply of blood to the right sinus forces it deeper into the mastoid process. For, as they say, the great horizontal blood-vessel of the dura does not generally divide at the torcula herophili into a right and left sinus, but it continues on as the right sinus, whilst the left sinus receives the lesser blood supply of the vena magna Galeni. *Under these circumstances, then, it would really seem as if the pressure of the blood current against the curves of the sinus would, during the growth of the bone, burrow for itself the deepest bed at that spot against which it was propelled with the greatest force.*

According to this idea the blood current in the brachycephalous sinus ought to press more forcibly forward and outward against the mastoid than in the dolichocephalous, because the posterior cranial fossa in brachycephalous skulls being broad and narrow, the sinus alongside will be more sharply curved than in the longer and narrower fossa of the dolichocephalous skull. A glance at Figs. 3 and 4 exhibits this suggestion to perfection. A is the brachycephalous sinus; B, the dolichocephalous; seen in Figure 3 from above, in Fig. 4 from one side. In both cases, x is the curve pressing against the base of the pyramid.

In conclusion, I hope that all who have the proper material at hand will investigate and verify my assertions.

Explanation of the Figures.

FIG. 1.—A, frontal section of a dolichocephalous skull with index of 1.42; B, frontal section through the right half of a brachycephalous skull with an index of 1.15.

Both sections are set alongside of one another, so as to compare the situation of both temporal bones.

Sections are made through spina supra meatum. The antrum is black; the portion to be chiselled out is dotted.

¹ *Festschrift fuer die 13 te Vers. der deutschen anthrop. Ges.*, Frankfurt a. M., 1882

A. m.—Antrum mastoideum.

L. temp.—Linea temporalis.

Sp. s. m.—Spina supra meatum.

FIG. 2.—Horizontal section through a mastoid process with "dangerous" location of the sinus. From Politzer. Lettering as in Fig. 1.

FIGS. 3 and 4.—Paraffine cast of the transverse sinus of a brachycephalous (A) and of a dolichocephalous (B) skull one half natural size. The casts are obtained in the following manner: A delicate rubber tube with walls 5 mm thick is carefully laid into the sulcus transversus and firmly affixed with strips of adhesive plaster. The cavity is next filled with melted paraffine under high pressure. After this has cooled, the skull, after repeated sawing, is torn asunder. The casts thus obtained are drawn with the ortho-pantograph, and reduced to one half of the natural size.

NEGLECT OF TREATING THE NASO-PHARYNX
A CAUSE OF FAILURE IN THE MANAGEMENT
OF CHRONIC SUPPURATION OF THE EAR.

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AURAL literature abounds in the relationships between naso-pharyngeal inflammation and "catarrh" of the middle ear, while little or nothing has been advanced with reference to diseases of the upper air-passages in connection with the treatment of suppurative otitis media.

There may be, of course, writings upon the subject with which I am unfamiliar; but I have yet to have a patient with suppurating ears tell me, when questioned as to previous treatment, that naso-pharyngeal inspection, medication, or surgical interference has formed any part of the care given them; and these observations have been made, largely, in the three aural clinics with which I am connected.

A brief report of three cases will save needless detail:

Nov. 13, 1885, John K. P., *aet.* twenty-one. History of ch. supp. left *tymp.* after bathing; of about ten years' standing. Constant, offensive discharge; uses *syringe* daily. Has had all sorts of applications made to his ear; has snuffed salt water into his nostrils and used gargles. Large circular perforation in anterior, inferior quadrant. Hearing for the watch, after *douching* ear and *inflation*, = $\frac{5}{40}$. Patient is a "mouth-breather." Left nostril almost occluded by deflected septum. Marked enlargement at extremity of both *turbinate* bodies. Smokes cigarettes, which fact the appearance of the whole surface of the pharynx betrays.

Treatment.—Cartilaginous septum straightened by crucial incision and plugs ; subsequent removal of the hypertrophied membrane at ends of turbinate bones by Jarvis snare ; pharynx treated by appropriate astringents ; and the ear kept clean by requisite applications of hydrogen peroxide and inflations. On two or three occasions, during the time he was under observation, I introduced, through a catheter, a few drops of a ten-grain solution of nitrate of silver to the left Eustachian tube. Patient ceased to visit my office Dec. 3d. Came again Jan. 3d. The discharge had then ceased. He said he could not remember the day when his ear stopped running. Thought it was about three weeks ago. Membrane was covered by an incrustation, which I did not disturb, as the hearing was $\frac{3}{5}$. He promised to let me know if discharge ever recurred, and he has not returned.

Carrie W., æt. eleven. History of chronic suppuration both middle ears since early dentition. Treated at various dispensaries for years. Has "had lots of polypuses cut out of her ears"; used a syringe several times a day, and never had her nose examined. When first seen at the Harlem Dispensary (in August, 1884), the meatuses were full of viscid, discolored, offensive pus, mixed with a powder (boric acid ?) that had been prescribed for her. The depth of both canals, after cleansing, presented masses of granulation tissue. I neglected to make the watch test until I saw her the third or fourth time ; but she was very hard of hearing for the voice. I do not believe she could have heard the tick of any watch. Patient was a "mouth-breather." Her tonsils were hypertrophied ; the vault of the pharynx was filled with pendulous "vegetations" ; and the mucous lining over the middle and inferior turbinate bodies was thickened and swollen. The septum was but slightly irregular.

Treatment.—The tympanic cavities were cautiously scraped, under cocaine, with a Buck's curette.

Both membranes were found to be destroyed, but the ossicles, except the manubria, were intact. Peroxide of hydrogen was used as a cleanser, etc. ; Valsalva's experiment performed ; and strong nitric acid applied.

At the same sitting the vault of the pharynx was scraped with a curette, which I devised and described in the *Medical Record* of Dec. 12, 1885 ; and the following directions were given : a weak solution of bicarbonate of soda, warmed, to be snuffed into the nostrils thrice daily, followed by the insufflation of this ointment :

R—Iodoformi	.	.	.	.	.	gr. iv.
Natr. biberat.	.	.	.	.	.	ʒ i.
Ol. gaulth.	.	.	.	.	.	♏ iii.
Petrolati	.	.	.	.	.	ʒ iv.

SIG.—Use after cleansing.

The ears to be kept clean and dry by the use of hydrogen, peroxide, and absorbent cotton, and the practice of Valsalva's inflation. At the next sitting I excised a small portion of the right tonsil, and under the influence of iodine alone the opposite gland gradually shrunk. Astringents were applied to the pharyngeal vault and nares. Progress was manifest from the start. It was more than three months before the drum-heads cicatrized, but during that time there was no offensive discharge ; the granulations returned only once, and the hearing was, with the aid of Toynbee's artificial membrana tympani, R. E. = $\frac{3}{40}$; L. E. = $\frac{5}{40}$.

Two sisters, aged respectively eight and a half and four years, previously inmates of an orphan asylum, were sent to my clinic at the Post-Graduate School early in February, 1886. Maggie, the elder, had a bilateral suppuration of over five years' duration, the result of scarlatina. The younger one's (Nellie's) left ear had been suppurating for more than two years, and the cause was traced to mumps. Ears presented the familiar appearance of neglect, although treated for a long time by syringing, ear drops and powders. The nasal douche had been recommended and employed. The hearing distance by means of the watch could not be accurately determined ; but both children heard ordinary conversation poorly. It was impossible to secure good rhinoscopic images in these cases, but the children were typical "mouth-breathers." The nostrils were almost collapsed, the tonsils were hypertrophic, and, inserting my finger behind the velum, I found the post-nasal space well filled with adenoid vegetations.

Treatment.—Vault scraped with my curette and afterwards with finger-nail. Projecting tips of tonsils snipped off with scissors, and subsequently painted with tincture of iodine. Nostrils dilated with cotton plugs, smeared with an ointment of tannin and vaseline. The suppurating ears were kept clean with hydrogen peroxide and a four-per-cent. solution of arg. nit. applied to the exposed tympanum, after drying and inflation. At the expiration of two weeks, the guardian of these children wanted to know "if it was necessary to come any more." There was little or no discharge from the ears, and the improvement in hearing was mar-

vellous ; the only thing, really, that remained to be done was to correct the habit of mouth-breathing. This was finally overcome by breathing exercises.

A favorite method with me is this : I teach the patient to take a deep, rapid inspiration through the nostrils, in three seconds, with the lips tightly closed ; then, without opening the mouth, prolong the expiration from ten to fifteen seconds. When practised five or six times daily, and continued for several minutes, I find that this does away very materially with shallow, mouth-breathing. So long, however, as the upper air passages are obstructed in any way, this cannot be well accomplished. *Inhalation through the mouth, under any circumstances, is abnormal* ; and the writer is certain that the inclination to mouth-breathing in consumptives is a leading cause of their well-known refractory aural suppurations.

These few cases illustrate sufficiently the salient points in a large class of aural patients, who do not have adequate management. It is to be feared that the process of repair in an exposed tympanum is, in the tedious and frequently empirical methods of treatment, often forgotten. Cleanliness, to maintain good drainage and to prevent decomposition, is indispensable ; but the mere checking of a purulent discharge is not a sufficient aim. What otologist has not, at some time, had this statement flung at him : "Yes, you have stopped the discharge, but you have made me deaf." Again, the possible danger to the mastoid cells should not be overlooked in our efforts to arrest secretion in the tympanum.

Another great stride will be made in our specialty, when all otologists become expert with the rhinoscopic mirror.

The treatment of naso-pharyngeal disease in connection with medication of the tympanum in chronic suppuration, will, on the whole, give very satisfactory results, while to neglect such treatment is to leave a large class practically unbefited.

THE RELATIVE FREQUENCY OF EAR DISEASES IN THE WHITE AND COLORED RACES IN THE UNITED STATES.

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IN the volume of the *Archives of Ophthalmology* for 1884 I published some statistics showing the comparative frequency of eye diseases among the white and colored races as found in my clinical service at the Central Dispensary. As these figures showed that race exercised a very marked influence on the prevalence of certain eye afflictions, it was considered a legitimate subject of inquiry as to how far race affected the relative frequency of ear diseases in our mixed population.

I am enabled now to present some statistics bearing on this point, collected from the same source. The numbers, it is true, are small, but they are quite sufficient, I believe, to show that there exists a very considerable difference in the liability of the two races to certain forms of ear disease. I append a tabulated statement prepared by my assistant, Dr. T. A. Taylor.

It will be observed, in the first place, that of the 373 cases 189 were white and 184 colored—that is to say, they were equally divided. In the eye clinic of the same institution the diseases were nearly twice as frequent among the negroes as among the whites (2,426 colored to 1,324 white).

The negro, then, is not subject as a race to ear diseases as frequently as the white man. It has been generally accepted, I believe, by all those who combine the practice of

Diseases.	White.	Colored.
Eczema of auricle	6	10
Furuncle of meatus	4	3
Impacted cerumen	12	15
Otitis externa	2	4
Occlusion of external meatus	1	
" " " " partial	1	
Polypus	2	2
Otitis catarrhalis, acute	19	34
" " subacute	4	6
" " chronic	20	23
" purul., acute	14	5
" " chronic	55	52
Sclerosis (dry catarrh)	38	9
Mastoiditis		1
Nervous deafness	5	4
Deafness following pertussus	1	1
Tinnitus aurium	2	1
Otalgia	2	2
Sebaceous cyst of auricle	1	1
Tumor of lobule	13	
Total	189	184
		373

ophthalmology and otology that among the white race ear diseases form from twenty to twenty-five per cent. of the cases observed, and the law holds good as to the white portion of my clinical service. In the negroes, however, the ear diseases amount to only about ten per cent. of the whole number of eye and ear cases presenting for treatment. The actual figures of the number observed during the same time are as follows:

	White.	Colored.
Eye diseases	788	1,512
Ear "	189	184

In this connection it may be stated that there is a legend to the effect that there is little or no deafness among the North American Indians. How far this is true I have never been able to determine from personal observation, but from inquiries of army surgeons and others who have lived among them I am satisfied that, at any rate, ear disease is not a necessary consequence of savagery or barbarism. On the other hand, eye diseases are, I learn, very common among the Indians, cataract being a frequent cause of blindness.

Coming down now to particular affections, it will be seen that while they are apparently more prone to the acute catarrhal diseases, and are quite as frequently affected with chronic purulent otitis media, *the negroes rarely suffer from dry catarrh*, which is the cause of so much of the incurable deafness in the white race. Those who do suffer from this malady have it in a mild form, and never, according to my observation, attain to that amount of deafness which renders ordinarily loud conversation difficult to understand.

Inspissation of the cerumen seems to affect both races in about the same proportion. It has been noticed by several observers that the negro girls are more often affected with *tumors of the lobules* than their white sisters. Whether this comes from the greater frequency of the practice of piercing the ears and wearing ear-rings among them than among the whites, or whether there is some race-predisposition to the formation of these tumors, it is difficult to tell, but probably both are factors in the production of larger percentage of the tumors in the negroes.

Since these statistics were collected and were being arranged for publication, Dr. T. E. Murrell, of Little Rock, Arkansas, read a paper on the same subject before the otological section of the International Medical Congress. I did not have the pleasure of hearing this paper read, and therefore do not know what his exact figures are, but I have read the abstract which he furnished for the programme of the meeting, and find that his general conclusions differ in some points of detail from mine. We are agreed as to the less frequency in general of ear diseases in the negro, but while he finds that chronic otitis media suppurativa is not often met with, my statistics show about an equal distribution of the affection in the two races. On the contrary, he does not seem to have noted the very great difference in the occurrence of dry catarrh as the statistics here presented show. It is to be hoped that others who have the opportunity of observing ear diseases in the two races together may be led to report the results of their observations.

NECROSIS OF THE LABYRINTH AND PARALYSIS OF THE FACIAL NERVE.

By DR. FRIEDRICH BEZOLD, MUNICH.

Translated, somewhat abridged, by DR. H. A. B. MACCAULEY, New York.

(*With a heliotype plate.*)

TOYNBEE, in 1864, in the first volume of the *Archiv für Ohrenh.*, directed universal attention to the relatively not infrequent occurrence of partial or total necrosis of the labyrinth, and since then the number of observations, especially of exfoliation in the living subject, has increased to about forty-five.

The inflammatory process in the middle and internal ears, which leads to this exfoliation, is not only prejudicial to the ear itself and the neighboring organs, especially the distribution of the facial nerve in the temporal bone, but the accompanying suppuration, which may continue months or years, is extremely dangerous. Bearing in mind the relative infrequency of necrosis of the labyrinth, I take the liberty of presenting the following five cases, which have come under my own observation during the last three years:

CASE I.—*Necrosis of a turn of the cochlea, or of a semi-circular canal, with temporary facial paralysis.*

Mr. J. K., 28 years old. R. otorrhoea since youth; same condition existed formerly on left side also. *March, 1883.*—Noticed sudden aggravation of symptoms on right side, with vertigo, unsteadiness of gait; right facial paralysis making its appearance at same time. The pain in head and ear was, at that time, very violent, but moderated after the removal of several polypi, and

the facial paralysis disappeared permanently. Present treatment consists of injections of a 1% solution of carbolic acid.

June 8, 1883.—I examined patient for the first time, and found neither swelling nor mastoid tenderness. A growth about half the size of a pea was seen on the superior posterior wall of the osseous portion of the auditory canal. The probe discovered the same to be a fistulous opening, through the centre of which the probe passed about 1 cm in the direction of the mastoid antrum. The opening discharged upon this an opaque secretion, a large quantity of which was afterwards removed by a curved tube introduced in the same manner. No trace was found of the membrana tympani. As far as can be seen the wall of the tympanum is covered anteriorly and posteriorly with superficial polypous growths. Politzer's method unsuccessful.

Right ear deaf to low conversation and the watch, but tuning-fork is heard through the air. Placed upon the vertex the same is heard in the relatively normal left ear. The polypous growths upon the internal wall of tympanum removed by the snare.

Toward the end of July, 1883, a larger growth appeared at the fistulous opening, after the removal of which a still larger mass, together with a couple of fragments of bone, were brought away by the syringe. One of these was shaped like a crooked tube, and was unmistakably a piece of a semi-circular canal, or from the cochlea. Direct injection into the aditus ad antrum removed a small cholesteatomatous mass of a dirty-yellow appearance, containing epidermic scales, with crystals of cholesterine. I regret to say that the hearing was not tested after this.

A letter was received from the attending physician, December 19, 1885, reporting entire cessation of the suppuration.

CASE II.—Necrosis of the lower turn of the cochlea, followed by subsequent facial paralysis.

Mr. G. N., 41 years old. Seen Oct. 9, 1883, for the first time. Has heard badly with left ear since youth, and remembers to have had evil-smelling discharge from the same ear for the last fifteen years. Father was also hard of hearing and had a discharge from the ear.

Since April, 1883, has had continuous pain, becoming so violent at times as to cause insomnia and inability to work. Towards end of May the discharge became more copious and has remained so ever since. Vertigo and tinnitus aurium were not present. About

a week ago a polypous growth was removed from the ear at Innsbruck, whereupon the pain increased. Paralysis of the left half of the face showed itself four days ago. Patient anæmic, with anxious expression of countenance, and gives impression of one very ill. Pressure on pars mastoidea seemed to give very little pain. A polypus, bleeding upon slight provocation, was seen in the external meatus, extending into the cartilaginous portion, and was removed at once with the snare.

Hearing.—Loud conversation (left) heard with closed as well as with the open ear. Right ear normal. Tuning-fork a¹ not heard by diseased ear through the air. When placed on vertex patient could not tell in which ear he heard it.

October 11th.—Pain in the ear has ceased. Yesterday evening patient had headache and went to bed; slept pretty well, however, for the first time after many sleepless nights. A sound introduced to-day into the external auditory canal strikes rough, bare bone behind the remaining stump of the polypous growth, and gliding over the same passes down deeper.

Oct. 13th.—Stump of polypous growth trimmed down with the snare.

Oct. 15th.—Sequestrum appreciable to a greater extent behind the growth, but removal with the forceps is not feasible. Up to Oct. 30th the discharge was moderate, with absence of pain. The growth, which had enlarged again, was removed.

Nov. 1st.—The rapidly increasing growth again removed. Sequestrum now visible.

Nov. 3d.—Growth was again snared off, and the sequestrum was extracted with the forceps, it breaking into three small fragments as it was removed. Patient goes home.

Nov. 25th.—No discharge since extraction. Feels strong and able to work. Some secretion, together with epidermic flakes, removed by the syringe. A small polypus about size of lentil removed by the snare from posterior wall of the osseous portion of auditory canal. Auditory canal now wide and free from granulations. The space in the depths is bounded by a gray, irregularly shaped surface, which gives bony resistance on contact with the probe. The innermost part of the posterior superior wall of the osseous portion of auditory canal is lacking, and a probe introduced passes more than 1 cm in the direction of the antrum. Cubic contents, right (normal ear with normal hearing distance), 1.1 ccm; left, 1.8 ccm. Tuning-fork a¹ on vertex is

heard in right ear from right mastoid, 10 seconds; on left mastoid process, 7 seconds. Rinne's experiment, right, + 32 seconds. Loud voice, with closed right ear, heard, left, at 6 cm; low conversation indistinctly understood, left, likewise with closed left ear. The facial paralysis persists unchanged.

Dec. 22, 1885.—Over two years after his illness patient reports return of health and strength. Ear has remained dry since treatment was discontinued. The complete facial paralysis noticed two years one and a half months ago, which was persistent at that time, the whole half of the face hanging down loosely, was to my great surprise no longer noticeable when the muscles were in repose. Galvanic and faradic irritability of the left facial nerve and distribution is not inconsiderably lessened. Intramuscular irritation shows a weaker contraction than on normal side, but of the same duration. There is, hence, simple diminution of electrical irritability without qualitative changes. This is probably the result of degeneration reaction.

Sequestrum.

(Heliotype plate, Fig. I., *a*, *b*, *c*, and *d*).

The three pieces into which the sequestrum broke consist of :

1. A large piece of the lower turn of the cochlea of distinctly characteristic form (Fig. I., *a* and *b*).

2. A small saucer-shaped piece, smooth and concave, likewise belonging to the cochlea (Fig. I., *c*), and

3. An irregularly notched fragment, whose exact relation to the cochlea could not be determined (Fig. I., *d*).

CASE III.—Necrosis of the lower and middle turns of the cochlea with permanent facial paralysis.

J. B., woodchopper, æt. forty-eight, seen by me March 9, 1885, for the first time. At age of seven was kicked by a horse on left side of head, and for three or four years had a discharge from the left ear and loss of hearing. The discharge then ceased and did not appear again until three months ago, and has continued since then; the patient giving as cause for the same his having taken a vapor bath for his rheumatism. With the re-appearance of the discharge complete left facial paralysis was noticed, which has persisted unchanged since then. Lately complains of violent pain in the left ear and sleepless nights. Discharge copious and fetid. Externally the pars mastoidea is apparently unchanged,

but gives pain on pressure on part corresponding to the mastoid antrum. The bottom of the auditory canal is filled by a mass consisting partly of thickened epidermis and partly of a red growth springing from posterior wall of the osseous portion of the auditory canal, this proving to be granulations surrounding the mouth of a fistulous opening. Politzer's method does not give perforation whistle.

The a¹ tuning-fork not heard through the air. The growth increased rapidly, and was removed March 12th, and again on the 16th. Rough, bare bone is now felt in the depths of the canal with the probe.

Inflation produces a thin whistling sound. March 24th and 29th growths about size of a pea were removed by the snare. April 1st the modiolus which lay free in the auditory canal was removed with forceps, together with the first turn of the cochlea. The canal is still narrowed by granulations in its depths. Perforation whistle on inflation. No vertigo or subjective noises have been noticed during the course of the disease. Up to May 7th there was no discharge to amount to any thing, although the deeper parts were still covered with easily bleeding granulations.

May 1st.—Discharge has ceased entirely, and perforation whistle is no longer obtained.

Jan. 14, 1886.—Ten months after removal of sequestrum there has been no return of suppuration. Politzer's method gives a dry blowing sound.

Hearing.—Right membrana tympani shows a whitish opacity with absence of normal reflex. The handle of the malleus projects more than usual, and the posterior fold is indicated. Hearing distance for low voice 90 cm. Tuning-forks A, a, a¹ on vertex. Patient claims to hear them in left ear with closed as well as open right ear. With the fork on the right processus mastoideus he locates the tone in the left ear. Tested later on, however, he hears it in the right ear. The deeper tuning-forks A, a, a¹ were not heard through the air with the left ear. a¹¹, c¹¹¹, and c¹¹¹¹ sharp were, however, heard with right ear firmly closed with the finger. With closed right ear low voice is not understood by left ear. The loud voice is heard about 12 to 15 cm, left, quite as well when the ear is closed. The patient was examined on same day for disturbances of equilibrium—with eyes open patient walks rapidly and turns with perfect facility—with bandaged eyes, however, some uncertainty of gait is noticeable. The facial paralysis

remains complete as before. When the right eye is closed, the left remains wide open. Perception of taste is lost for sweet, bitter, sour, etc., in anterior portion of left half of the tongue.

Examination of *N. facialis* showed complete degeneration reaction, the nerve giving no response to either galvanic or faradic current. The muscles gave no response to the faradic, but contract weakly with galvanic current (without reversion of the contraction formula). The sensibility of the muscles to the galvanic current is partially diminished, corresponding to the late stage of the paralysis.

Sequestrum.

(Heliotype Plate, Fig. II., *a* and *b*.)

The sequestrum removed consists of the base of the modiolus and the parts of lower and middle turns of the cochlea which are adjacent to it; also that part of the beginning of the lower turn running straight towards the *fenestra rotunda*. From within the fundus of the *porus acust. int.* (Fig. II., *b*), with the central part of the *tractus spiralis foraminulentus*, appears distinctly visible. This part of the sequestrum is uneven owing to superficial erosion. From without (Fig. II., *a*) the smooth floor of the second turn of the cochlea is seen with the regularly arranged apertures for the passage of vessels and nerves running spirally upwards on the modiolus. The upper part of the modiolus is broken off, the *canalis centralis* and *spiralis modioli* opening into the point of fracture. The central part of the *lamina spiralis ossea*, which divides the lower turn into *scala tympani* and *scala vestibuli*, is still present along the whole lower turn.

*CASE IV.—Necrosis of the lower and middle turns of the cochlea, including a part of the vestibule, with permanent facial paralysis.*¹

Jas. Dallmeyer, fourteen months old. First seen Jan. 27, 1883, when he had a fetid discharge from left ear for seven months previous to this time. Lately frequent pain and insomnia, also repeated hemorrhages from left ear—for the last three months, according to the mother, he has not been able to close his left eye. Complete facial paralysis is now present. The auricle appears raised up from its insertion, presenting the peculiar right-angle appearance to the side of the skull so characteristic of an affection

¹ This case has already been briefly reported by me in the *Aerztliches Intelligenzblatt*, 1884, No. 49.

of the bony pars mastoidea in its anterior half. An incision, the result of an operation at other hands, is found directly behind the auricle, and is still open, the probe passed into the same glides inwards and forwards about 4 cm, but no bare bone is found ; the probe passed into the auditory canal, however, strikes at once upon the sequestrum, quite close to the entrance. The next day under anæsthesia an incision 3 cm in length was made down to the bone, extending from the linea temporalis to the apex of the tumor behind the auricle, the pars mastoid. was found to be rough and bare, with a large hole in^o the bone filled with granulations which were scooped out with the sharp spoon. A row of small sequestra were then removed with forceps from the posterior wall of the auditory canal, and the probe in the external meatus could then be passed in 4 cm deep, measuring from the tip of the tragus. Drainage and iodoform dressing.

January 31st.—Dressing changed. Wound clean and without reaction. There is still a discharge from the auditory canal.

February 7th.—Discharge moderate and odorless. Wound communicates freely with auditory canal and pharyngeal space. Wound is funnel-shaped, with healthy granulations at the bottom. The probe passes into it about 3 cm deep, no bare bone being encountered. The fistulous opening was kept open, and the discharge from it was very slight, and without odor for a few months following, the child in the meantime getting stronger generally. At the beginning of July the discharge got copious again, and was at times bloody. There was a return of pain, especially when the ear was syringed. Insomnia.

July 4, 1883.—A new and larger sequestrum found in auditory canal and removed by the forceps, anæsthetics not being necessary. The sequestrum lay imbedded in granulations, and consisted of the greater part of the labyrinth, with exception of the semi-circular canals and inner wall of the tympanum. The probe could now be passed in 4 cm deep into the auditory canal, and here encountered bony resistance. It could still be passed into the fistulous opening behind, but no bare bone was met with.

After removal of the sequestrum the discharge became very slight, with quiet nights, and the fistula behind the ear closed up in a short time. The child remained under observation several months, a very slight odorless discharge still existing. It was impossible to examine the tympanum thoroughly owing to the narrowed auditory canal. It was, however, freely accessible from the

Eustachian tube, as shown upon injection into the meatus, the stream running down into the pharyngeal space. The facial paralysis persists unchanged.

Sequestrum.

(Heliotype Plate, Fig. III., *a, b.*)

The sequestrum embraces the same portion of the labyrinth as in the preceding case. On its outer surface is seen the base of the modiolus, with the first and the beginning of the second turn of the cochlea, and a considerable piece of the inner surface of the vestibule.

The lower turn of the cochlea, whose lateral wall is missing, as in the preceding case, shows the lamina spiralis ossea well preserved, and, as before, dividing it into two unequal parts, the inferior of which is continued forward to the anterior inner edge of the fenestra rotunda, with the crista semilunaris running transversely across it (Henle). The beginning of the scala vestibuli is well seen, including with it a large piece of the wall of the vestibule (the recessus hemisphaericus complete), and the greater part of the recessus hemiellipticus, between both the crista vestib. On the inner side (Fig. III., *b.*) almost all of the fundus of the porus acusticus is plainly visible; the greater part of the tractus spiralis foraminulenta is seen in addition to the different groups, for the passage of the vestibular filaments of the acusticus, including the ramus inferior, which passes through a separate canaliculus to the inferior ampulla. The canal for the facialis, as far as its hiatus at the genu forms a groove in the upper part of the sequestrum (Fig. III., above and to left). The bony wall of the porus acust. int. is smooth, as is also the side of the vestibule, the mouths of the canaliculi for the rami vestib. being somewhat enlarged.

I saw the child again Dec. 6, 1885, two and a half years after the removal of the piece of the labyrinth, and verified the following: There has been no return of the discharge, and no pain. Behind the auricle, and inferior to the linea temporalis, there is a deep depression, which takes in the greater part of the pars mastoidea. The auditory canal ends in a "cul-de-sac," at a depth of 19 mm measured from the apex of the tragus, the obstacle to further passage affecting bony resistance at all points except a small spot in the centre, where the probe, upon strong pressure, makes a slight impression. Tuning-fork a^1 upon the vertex is heard in healthy right ear. With right ear closed, A , a , a^1 , a^{11} , are not heard through the air, while c^{111} is heard. The

facial paralysis is persistent and complete. The tongue is deflected towards paralyzed side, especially when forcibly thrust out. Muscles of the tongue anteriorly are equally well developed on both sides. The uvula remains straight when at rest, as well as during phonation. Owing to patient's youth it is impossible to test exactly the perception of taste in the region supplied by the chorda.

Remarks.—As it was impossible to test the hearing in this case during the course of the disease, owing to the youth of the patient, and the history being also somewhat obscure as to the beginning of the pain and other symptoms, our only "point d'appui" upon which we may base a supposition as to the time of the commencement of the labyrinth process is found in the facial paralysis, the appearance of which was noticed by the mother about nine months before the exfoliation of the sequestrum in the auditory canal. As the facial paralysis had already existed three months when the pars mastoidea was opened, and the sequestrum removed from the posterior wall of the auditory canal, it is very likely that the necrosis of the labyrinth commenced simultaneously with that of the pars mastoidea, the sequestrum proceeding from the former requiring a longer time for its exfoliation. Part of the sequestrum belonging to the first turn of the cochlea extends as far as the fenestra rotunda, and I think that we may safely conclude that the disease was in this way transmitted from the middle to the internal ear, as in both the preceding cases.

The sequestrum in Case III. showed on its inner surface a small piece of the wall of the porus acust. int., viz., a portion of the tractus spiralis foraminulentus; while the sequestrum in Case IV. shows a still larger piece of the internal auditory canal with smooth walls. The thickened dura mater with its outer granulating surface is, then, the only obstacle to an extension of the process to the pia mater and brain.

The atresia of the osseous auditory canal is also worthy of notice, and is accounted for partly by the necrosis of the posterior wall and the subsequent cicatrization, and partly by the constant and long irritation kept up by the sharp

edges of the sequestrum located at that position. It has, however, no bearing upon the future of the case, as the suppuration had completely ceased before the atresia took place.

CASE V.—*Necrosis of the whole labyrinth, with facial nerve intact.*

Mrs. Anna Stirnweiss, of Regensburg, forty-five years old, sent to me by her attending physician for the removal of a polypus in the left ear, with the remark that she had already had caries of the right temporal bone. The history, as obtained by me Sept. 19, 1885, is as follows: In her eighth year, R. otorrhœa from scarlet-fever, off and on—most severe from eighteenth to twenty-fourth year. In twentieth year, abscess behind ear broke and suppurated copiously for a year. Otorrhœa continued. In thirty-sixth year, perforation behind ear again. In thirty-ninth year, she removed a solid mass from the ear canal with a hair-pin—the sequestrum (Fig. IV.). L. otorrhœa for eight or nine years. A polypus removed with snare. Copious hemorrhage arrested with perchloride of iron. Loud voice, R, not perceived; L, at 16 cm.

Status præsens.—R: behind auricle a depressed scar, through the open centre of which the probe penetrates 19 mm deeper. The interior of the mastoid process is a large cavity, from which the probe and syringe remove epidermis having the characteristic odor of cholesteatoma. The meatus auditor. ext., with its mastoid extension, holds 2.8 gms of water.

The entire muscular distribution of the facial nerve is normal. Perception of taste in the anterior third of the tongue is present on both sides. A part of the left *M1* (superiorly), including the handle of the malleus, seems to be present. The soft, closely trimmed root of the polypus was cauterized with the solid stick of arg. nitr.

Sequestrum.

(Heliotype plate, Fig. IV., *a* and *b*.)

The sequestrum exfoliated in this case includes the entire labyrinth, almost entirely shut in by walls on all sides, with smooth outer surfaces as though they had been polished. Its greatest length amounts to 19 $\frac{1}{2}$ mm, greatest height 13 $\frac{1}{2}$ mm, greatest thickness 7 $\frac{1}{2}$ mm.

Its smooth inner surface (Fig. IV., *b*) shows two shallow

depressions taking in the greater part of its extent, divided from each other by a vertical seam or elevation. That toward the apex of the pyramid (Fig. IV., *b* left and above) represents the porus acust. int. changed into a shallow depression, while the one towards the base of the pyramid corresponds to the fossa subarcuata. The inner ear canal, notwithstanding its walls are perfectly smooth, has become flattened and is wider. The outer surface of the sequestrum (Fig. IV., *a*) is formed by the whole of the inner wall of the tympanum, and a considerable portion of the inner wall of the antrum mastoideum. The promontorium presents as a smooth polished elevation projecting from the former.

Remarks.—The morbid process resulting in this extensive sequestrum began at the age of eight years as a complication of scarlet-fever. It is impossible to decide whether the labyrinth was at that time implicated in the suppuration which led to its eventual extensive necrosis. Unmistakable indication of bone disease was first given by the fistulous opening behind the ear at the age of twenty years, the same closing up temporarily until her thirty-sixth year, when an opening was again established. Three years later the patient herself removed the sequestrum from the ear canal without difficulty. The condition of the sequestrum itself as described would seem to indicate that its exfoliation took place early in life, rather than at a later period. According to Volkmann¹ pus never effects a simple chemical disintegration of the bone, but changes it by producing inflammation, provided it be living bone. It has no influence whatever on dead bone, and the sequestrum may lie for years in its investing sheath, bathed in pus, without perceptible change.

The Present Literature of the Necrosis of the Labyrinth.

In order to get a better insight into the occurrence, ætiology, course, and sequelæ of labyrinth necrosis, with its resulting disturbances of function and complications, I have taken the liberty of appending a comprehensive compilation of cases as found in our later literature, as far as acces-

¹ "Handbuch der Chirurgie," von Pitha and Billroth, vol. ii., 2, 1, page 289.

sible to me, arranged in the order of their time of publication. I have also added my five cases, and in view of the universal interest in this form of disease, think it no imposition upon my readers to present these statistics in the following pages.

Supplementary Remarks.

Besides the cases mentioned in the statistics to follow, I remember also to have seen a case reported by Burckhardt-Merian. Richey's case (*Chicago Med. Journal*, vol. xxvi.), described in Politzer's text-book, was not accessible to me; likewise the exact history of Blake's case of exfoliation of the cochlea and walls of the vestibule, mentioned in the *Zeitschrift f. Ohrheilk.*, vol. ix., p. 388.

Since the completion of this article Kirchner has published a case of extrusion of the cochlea (*Münchener med. Wochenschrift*, No. 10, 1886); also Roosa and Emerson (last number of vol. xv., *Zeitschrift für Ohrheilk.*) have reported in detail a case in which almost the whole of the temporal bone, including the pyramid, was eliminated, this probably being the most extensive case of necrosis of the temporal bone resulting in cure ever reported. I have not been able to use these last two, they having reached me after my article was finished. There are probably a number of unpublished cases, and I may have overlooked some already published, but in spite of this I think forty-six cases quite sufficient to give my compilation a solid foundation.

Bibliography of Forty-six Cases.

(The German original contains a synopsis of the cases in tabular arrangement.)

- CASE 1.—Linnecar, nach Tod, *Froriep's Not.*, Band xxxvi., p. 158, 1833.
- CASE 2.—Crampton, *Praktische Beob. ueber Ohrenheilk.*, Wilde text-book.
- CASE 3.—Ménière, *Gaz. méd. de Paris*, 1857, No. 50.
- CASE 4.—Ménière, *ibid.*
- CASE 5.—Giberto Schotti, *Schmidt's J.*, Band cii., p. 54, 1859; from the *Gazz. Lombard.*, No. 35, 1858.

CASE 6.—v. Tröltsch, *Virchow's Arch.*, vol. xvii., p. 39, 1859, and *Ges. Beitr. zür path. Anatomie des Ohres*, 1883, p. 106.

CASE 7.—Shaw, after Toynbee, *ARCHIVES OF OTOTOLOGY*, vol. i., p. 113.

CASE 8.—Hinton, *ibid.*, and in Böten's *Inaug-Dissertation*, Halle, 1875.

CASE 9.—Toynbee, *ibid.*

CASE 10.—Toynbee, *ibid.*

CASE 11.—Toynbee, *ibid.*

CASE 12.—Agnew, after von Tröltsch, *Arch. f. Ohr.*, vol. i., p. 158.

CASES 13 and 14.—Gruber, *Allg. Wiener med. Zeitung*, vol. ix., 1864, Nos. 41, 43, 45.

CASE 15.—Voltolini, *M. f. O.*, 1870, No. 6, Präparat von Jacobi.

CASE 16.—Pommeroy, *Schmid's F.*, 1873, vol. clx., p. 295.

CASE 17.—Guye, *Arch. für Ohrenh.*, vol. viii., p. 225, and vol. x., p. 302.

CASE 18.—Parreidt, after Schwartze, *Arch. f. Ohr.*, vol. ix., p. 238.

CASE 19.—Böck, *ibid.*

CASE 20.—Cassels, *ibid.*

CASE 21.—Dennert, *Arch. f. Ohr.*, vol. x., p. 231.

CASE 22.—Lucae, *Arch. f. Ohr.*, vol. x., p. 236.

CASE 23.—Delstanche fils, *Arch. f. Ohr.*, vol. x., p. 301.

CASE 24.—Spencer, *Arch. f. Ohr.*, vol. xi., p. 73.

CASE 25.—Schwartze, *Arch. f. Ohr.*, vol. xii., p. 115, and observations made with v. Tröltsch and Burckhardt-Merian.

CASE 26.—Dennert, *Arch. für Ohr.*, vol. xiii., p. 19.

CASE 27.—Niemetschek, Prague, Schwartze's "Path. Anat.," p. 124.

CASE 28.—Schwartze, *A. f. O.*, vol. xiii., p. 98.

CASE 29.—Michael, *Zeitschrift für Ohrenh.*, vol. viii., p. 300.

CASE 30.—Gottstein, *A. f. O.*, vol. xvi., page 51, supplemented by the history of Jacoby's case, *A. f. O.*, vol. xv., p. 295.

CASE 31.—Schwartze, *Arch. für Ohr.*, vol. xvii., p. 111, in collaboration with Schede.

CASE 32.—Politzer's text-book, vol. ii., p. 596.

CASE 33.—Pollak, *St. Louis Zeitschrift für Ohr.*, vol. xi., p. 100.

CASE 34.—Habermann, *Arch. f. Ohr.*, vol. xviii., p. 87.

CASE 35.—Christenneck, *Arch. f. Ohr.*, vol. xviii., p. 293, from Schwartze's Poliklinik.

CASE 36.—Moos, *Zeitschrift für Ohr.*, vol. xi., p. 235.

CASE 37.—Jakoby, *Arch. für Ohr.*, vol. xxi., p. 54.

CASE 38.—Jacobson, *A. für O.*, vol. xxi., p. 304, from Lucae's university clinic.

CASE 39.—Gruber, *M. für O.*, No. 8, 1885.

CASE 40.—Walter Pye, *British Med. Journal*, June 13, 1885,
p. 1194.

CASE 41.—H. W. Phillips, *The Brit. Med. Journal*, July 4, 1885,
p. 16.

CASE 42.—My own case, No. 1.

" 43.—" " " " " 2.

" 44. — " " " " " 3.

" 45 = " " " "

" 46 = " " " " 5.

Gender.

In the forty-five cases given, twenty-four were male (among whom was one of exfoliation of the cochlea on both sides), fourteen females, and seven sex not given, making forty-five in all.

Necrosis of the labyrinth has therefore been observed in the male almost twice as often as in the female. My statistics hence confirm a certain predisposition in the male. Owing to the greater number of cases this is, however, not so evident as in Böter's statistics, where of sixteen cases only two were female.

Age.

In the preceding the age has been given when the sequestrum was removed from the ear. It is much more important, I think, to know the age at which the inflammatory process leading to the necrosis commenced. This is not known in most of the cases, and hence our statistics leave us in the dark upon this point. Arranged according to age, the figures are as follows. From the age of

0 to 5 years	.	.	.	.	.	.	8
5 to 10 "	.	.	.	.	.	.	10
10 to 15 "	.	.	.	.	.	.	3
15 to 20 "	.	.	.	.	.	.	2
20 to 30 "	.	.	.	.	.	.	7
30 to 40 "	.	.	.	.	.	.	6
40 to 50 "	.	.	.	.	.	.	4
Over 50 "	.	.	.	.	.	.	3
Age unknown	.	.	.	.	.	.	2
 Total	.	.	.	.	.	.	45

According to these figures age would seem to predispose during the first ten years of life. This, I think, is partly due to the predisposition to catarrhal and suppurative processes of the middle ear at that time of life, particularly the more severe forms following the acute exanthemata. On the other hand, this tendency in children to labyrinth necrosis, *as compared to the adult*, is explained also by the enormous difference in the proportionate size of the labyrinth at the different periods of life. At birth the labyrinth has already nearly attained its normal development; it is, proportionately, therefore, sixteen times greater in the infant than in the adult. Corresponding to this there is a remarkably rich blood supply of its bony walls as compared to the adult by the vessels of the fossa subarcuata.

Lucae¹ found the arteria subarcuata at seven months old almost as large as the art. auditiva int. Very numerous and large vessels pass into the semi-circular canals, and envelop the membranous canals with a vascular network. The importance of this as an ætiological factor of the inflammatory process in the bony labyrinth has been fully shown by Lucae in the interesting communication above mentioned. As is shown by the decreasing figures, the number of cases diminishes with advancing age. Over fifty-five years there is no such case on record.

Ætiology.

The acute exanthema, especially scarlet-fever, seem to be a particularly important ætiological factor in labyrinth necrosis, as indicated by the large number of children attacked. The commencement of suppuration in seven of the cases tabulated was directly traceable to scarlatina, while measles were the cause in two cases. In the majority of cases of scarlatina where the middle ear is attacked, the *Mt* shows extensive ravages from the beginning, most always causing exfoliation of the ossicles. The primary acute suppuration of the middle ear does not necessarily attack the labyrinth at the same time, but, rather, extends to it after a greater

¹ *Virchow's Arch.*, vol. lxxxviii., page 556. "Ueber Hämorrhagie und hämorrhagische Entzündung des kindlichen Labyrinthes."

or lesser period of time. The repeated attacks lead to an accumulation of pus, which is never completely discharged, and the process gradually encroaches upon the realm of the internal ear with resulting necrosis. As shown by Burckhardt-Merian¹ and myself² the suppuration caused by scarlet-fever may, if left to itself, continue all through life, unless interrupted by some complication leading to a fatal issue. In the seven cases of scarlet-fever mentioned in the table, the time which elapsed between the commencement of the exanthematous process and the exfoliation of the sequestrum was as follows:

1. Case 34 (girl, five years), exfoliation one year after otorrhœa, a fistulous opening being established of the pars mastoid. simultaneously with the latter.
2. Case 40 (girl, four and three-quarters years) after one and three-quarter years; fistula of pars mast.
3. Case 7 (boy, seven years), after two and a-half years.
4. Case 26 (girl, seven years), four years after fistula of pars mast.
5. Case 36 (man, twenty years), thirteen years after.
6. Case 28 (adult, twenty years), demarcation of the sequestrum observed at the post-mortem fourteen years after scarlet-fever. Two fistulous openings of pars mast. which had existed for a year or more.
7. Case 46 (woman, thirty-nine years), thirty-one years after. An opening behind the auricle had existed for nineteen years.

From the above it is seen that necrosis of the labyrinth, as a sequel of scarlet-fever, makes its appearance years after the fever, and is frequently accompanied by destructive processes in the pars mastoid., leading to fistula of its external wall (in five of the seven cases). The necrosis following the two cases of measles shows a similar relation; exfoliation in Case 21 taking place four years after the fever, that of Case 24, twelve years after. In the first a sequestrum

¹ Volkmann's Sammlung klinischer Vorträge No. 182: "Ueber den Scharlach und seine Beziehungen zum Gehörorgan."

² Gesammbericht über die 1881-1883 behandelten Ohrenkranken, *Arch. f. Ohrenheilk.*, Bd. xxi., p. 221.

had been already removed one year before, while Wilde's incision was necessary in the latter ten months previous to the exfoliation.

Symptoms of scrofula or syphilis were not found in the cases tabulated. Miliary tuberculosis was found in Case 19 (three and a half years, male) and Case 37 (fifty years, male) at the post-mortem, the remaining cases showing no signs of the same. There is, therefore, no reason to suppose, from the cases tabulated, that the different diatheses specially predisposed to the labyrinth necrosis. In the majority of cases we must make the inflammation of the middle ear, with the accompanying suppuration, responsible for it. In three cases the origin of the otorrhœa was traumatic. Case 5 (Schotti) had fallen from a ladder, striking upon the head. The suppuration did not take place, however, until two years after the fall. The ætiological connection is hence doubtful.

In Case 22 (Lucae), nine years before exfoliation, after a shooting match, had hemorrhage and pain in ear, with deafness since then. Traumatic perforation probably took place in this case; this leading to the otorrhœa years after.

In Case 42 (Bezold) loss of hearing and otorrhœa had followed a kick on the head, the symptoms disappearing three or four years later, but appeared again after a lapse of thirty-seven years. A vapor bath was given as the cause of this. Not quite four months later the greater part of the cochlea was removed from the ear canal. The reappearance of suppuration in this case after so long a pause was probably caused by the water penetrating through the perforated membrana tympani.

Duration of the Morbid Process.

Passing to the consideration of the duration of the suppurative process, the forty-six cases are to be divided into two categories:

1. The thirty-seven cases in which exfoliation and extrusion took place in life; and
2. The nine cases where death happened before elimina-

tion, the sequestrum remaining in place, showing more or less complete demarcation at the time of the post-mortem.

We are almost always justified in reckoning the duration of a suppurative middle-ear affection from the time of the beginning of the primary otorrhœa, when the same was of any consequence. This is also true of those cases where periods of time, more or less long, sometimes years, elapsed between the exacerbations, for, on the one hand, experience teaches us that an otorrhœa persisting for any length of time almost always causes extensive ravages of the *Mt* and middle-ear space, which do not permit of a spontaneous conclusion of the inflammatory process. On the other hand, a careful examination convinces us that the cessation of the suppuration is only apparent, and that the fetid odor still persists, with fluid secretion, in the depths of the ear, but in such small quantities that it is not discharged from the ear canal. A part of the secretion in such cases may find its way through the Eustachian tube; another part, becoming inspissated, remains in the osseous auditory canal.

Commencing from the beginning of the otorrhœa, as first remembered by the patient, we find the duration of the process, leading finally to exfoliation of the labyrinth, to be as follows:

GROUP I. (where extrusion in life):

Duration.	No. of Cases.	Infectious Disease.
2 to 8 months.	2	
1 " 2 years.	7	2 scarlatina.
2 " 3 "	2	1 "
3 " 4 "	2	
4 " 5 "	4	1 scarlatina, 1 measles.
5 " 10 "	3	
10 " 15 "	2	1 scarlatina, 1 measles.
More than 20 years.	2	
" " 26 "	1	
" " 31 "	1	
" " 32 "	1	
" " 41 "	1	Scarlatina.
Several years.	2	
Unknown.	7	
Total . . .	37	

GROUP II. (cases ending in death):

Duration.	No. of Cases.	Infectious Disease.
8 months.	1	Phthisis.
2½ years.	1	"
5 "	1	
7 "	1	
8 "	1	
12 "	1	Scarlatina.
More than 20 years.	2	
Unknown.	1	
Total	9	

From the above summary is seen that in thirty-eight cases only two lasted less than a year before exfoliation of the sequestrum, and only one case where death resulted eight months after the beginning of suppuration. The rest of the patients had a discharge at least one year, most of them much longer; in twenty-one cases over four years, eight of the same having existed interruptedly or continuously for over twenty years. Now, according to the experience of surgeons, demarcation and exfoliation of a necrotic part of the skeleton, especially of such a small part as occupies us here, would hardly require a longer period of duration than one year. We are hence justified in supposing, at least in the majority of the cases, that the development of the necrotic process was secondary to the otorrhœa; further than this, we may also conclude, judging from the length of time occupied (in some cases, ten to twenty years), that it was not the primary otorrhœa, but one of the many exacerbations that influenced directly the destructive process involving the labyrinth.

Upon nearer consideration of the three above cases where the otorrhœa was of comparatively short duration, we find in the first case (Lucae, Bibliog., No. 22), in which the discharge had existed only eight months before exfoliation, that after attendance at a shooting match nine years before, certain symptoms were noticed, viz., pain, hemorrhage with subsequent deafness, indicating a traumatic lesion of the *Mt*, together with more extensive destruction. In the sec-

ond case (Jacoby, Bibl., 37) death was due to tuberculosis, and there was probably otitis media purulenta phthisica, which, as has been already demonstrated by numerous post-mortem observations, including my own, may lead, in a relatively short period of time, to extensive necrosis of those parts bordering on the diseased middle ear, the rapid course of the disease being due to the existing diathesis.

The case of Christinneck from Schwartz's polyclinic (Bibl., 35) forms a notable exception well worthy of emphasis. Not only was the duration of the suppuration remarkably short before the appearance of the necrotic cochlea in the ear canal (two months), but the course of the disease showed other peculiarities which do not appear in any of the other cases tabulated. The patient, a man of fifty-four, who was healthy previous to the beginning of Aug., 1880, was suddenly taken at that time with vertigo and faintness, followed by vomiting and pain in right side of head, the same continuing three days uninterruptedly. No loss of consciousness, but pain in region behind ear. Twelve weeks later, otorrhœa with remission of the pain, so that he could lie upon the diseased ear. Eight days after the appearance of the discharge the face was distorted.

The ear canal was already full of pedunculated polypi. Jan. 7, 1881 the necrotic cochlea was removed. It is a pity that this case was not under observation from the beginning. If we can rely upon the statements of the patient, we are almost driven to accept the supposition of a primary inflammation ending in necrosis of the labyrinth; the early phenomena, that of pain excepted, corresponding exactly to the characteristic symptoms of Ménière, coming prominently into the foreground. Twelve weeks later the discharge began, and eight days after this facial paralysis. This is, however, the only case among all of those tabulated, including my own, where the rapid course of the disease and the succession of the symptoms would indicate the labyrinth as the primary seat of the inflammation instead of the middle-ear space. In the great majority of the cases it is evident from the period of duration of the otorrhœa, that the labyrinth could only have been attacked secondarily.

Inflammatory Phenomena.

While the necrosing process was going on, the discharge was continuous and profuse, with a fetid odor which did not entirely disappear under antiseptic treatment, until the sequestrum had exfoliated. Among other inflammatory symptoms pain and the formation of polypi were the most constant.

In the forty-six cases mentioned pain was present in thirty; in thirteen of the cases the history leaves us in doubt as to its presence, while in three cases it is positively mentioned as having been absent. As its presence depends not only upon the labyrinth process itself, but also upon the inflammatory destruction of the middle ear, its duration may extend over a period of years, and is not confined to the ear, but involves the whole of one half of the head. Headache is mentioned in sixteen of the cases, but was partly due to meningeal and brain complications. The frequent participation of the pars mastoid. would lead us to expect mastoid tenderness; this was, however, not always present. The pain appearing in the last months of the disease was undoubtedly caused by the sequestrum itself, if not by the demarcation, at least by its passage when it reached that part of the osseous canal so richly supplied with sensory nerves. The continuous violent pain at this time makes the picture of disease a pronounced one. Many authors mention the peculiar anxious expression of countenance, this being also very apparent to myself. The insomnia, lasting weeks, perhaps months, causes considerable disturbance of nutrition, and the patient becomes pale and thin, presenting a cachectic appearance. Where there are no complications, pain disappears with the removal of the sequestrum. Great relief is also given by the removal of the polypi, which obstruct the discharge of pus and the emigration of the sequestrum. After the removal of the sequestrum the patient recuperates in a most remarkable manner, and one is often astonished to see the previously decrepit individual a strong hearty man a few months after. Temperature and chills were reported in only a comparatively small number of the cases, and then seemed to

have been caused by extension of the suppurative process to the meninges, sinuses, and the soft parts of the pars mastoid. In two cases where the sequestrum made its exit through a fistulous opening behind the ear, fever was present from beginning to end.

Demarcation and passage of the sequestrum through the tympanum and ear canal, accompanied by fever, seemed to be the exception (Moos' case, Bibl., 36). Polypoid proliferation was present in all cases of exfoliation before death, the same being partly developed before the implication of the labyrinth by the influence of the middle-ear process, and are always present at the time of the passage of the sharp-cornered sequestrum through the ear canal. In the most intense cachexiæ, especially the last stage of phthisis, there seems to be an insufficient formation of granulations, and in these cases there is also no extrusion of the sequestrum, the same remaining in its original situation. The polypoid proliferation is most abundant in the tympanum, edge of membrana tympani, and external ear canal; also, as shown by von Tröltsch (Bibl., 6) in the Eustachian tube. They may completely fill the auditory canal, projecting from its external opening,—pedunculated forms being found, as well as the true polypi (with epithelial covering, etc.); more seldom a diffuse granulation tissue forms on the walls of the canal. As long as the sequestrum lies imbedded behind these polypoid proliferations (which bleed easily), they sprout forth again as fast as removed, until the extraction of the sequestrum, when rapid involution takes place. In the 37 cases ending normally by exfoliation of the sequestrum, polypi or simple granulations were present twenty-seven times.

Fifteen of these were true polypi with pedicles, or at least growths requiring removal with the snare. Twelve are simply described as proliferations or granulations, while in only ten of the cases, mostly with very brief histories or of long date, no mention whatever is made of proliferous growths. Also, in the nine cases where death ensued before complete demarcation or change of position of the sequestrum, six showed polypi. Von Tröltsch

(Bibl., 6) found the origin of the same in his case to be in the ear canal, on the edge of the *Mt*, and in the Eustachian tube, while Schwartz (Bibl., Case 28) found they originated in the tympanum. In the other three cases, no mention is made of their presence whatever.

Disturbances of Equilibrium.

Ever since the experiments of Flourens the labyrinth has been thought to be an organ of the sense of equilibrium, and clinical experience confirms this supposition most satisfactorily. The very frequent occurrence of disturbance of equilibrium with disease of the organs of hearing, especially of the nervous apparatus, leaves no doubt in our minds that in the labyrinth we have an organ for the preservation of the equilibrium. An almost unmistakable indication of this is seen in its anatomical structure, with the semicircular canals arranged in planes perpendicular to each other. By reference to the preceding statistics, we find that such disturbances were noticed in only a fractional part of the cases, and then mostly at the beginning, and lasting only temporarily. More than this, it is very probable (almost sure) that in a number of cases the vertigo was due to direct cerebral irritation caused by meningitis or cerebral abscess, and consequently would not here be considered. In the forty-six cases there were only twelve in which vertigo was positively mentioned as a symptom; in four of the cases under three years it was not observed, while in twenty-three cases no mention is made of it whatever, although in other respects the history is in detail. It is therefore reasonable to suppose it was absent in the majority of these cases. In seven other cases positive mention is made of its absence. In the twelve cases where it was present, the vertigo appeared once in one and a half months, once in three and a half months, twice in five months, once in six months, once in eight, once in nine, and once in eleven months, before the removal of the labyrinth by spontaneous or operative means (Bibliography, 36, 25, 35, 40, 9, 22, 18, and 24). In one case (Bib., No. 12) the symptoms had existed "for months," and in still another (Case 37) vertigo with noises

in the ear appeared eight months before the post-mortem, at which time the labyrinth showed complete demarcation. It is often stated that the disturbance of equilibrium commenced at the time of the beginning of the otorrhoea, or an exacerbation of an old discharge, with increase of pain in head and ear, and in Case 35 of Christenneck, which has already been specially mentioned owing to its peculiar course, it even preceded suppuration by twelve weeks. Repeatedly the vertigo was coincident with the appearance of facial paralysis. Vertigo is therefore not regularly present as an initial symptom of labyrinth necrosis; but we are justified in connecting it with the beginning of the extension of the suppurative process from the middle ear to the labyrinth. It may be absent entirely, when the affected ear was completely deaf beforehand, as in Case 44, described by me. Also at this period it does not seem to be dependent upon the labyrinth affection itself, but rather owing to the cerebral and meningeal complications. In Case 18, for instance, in addition to the vertigo existing nine months before extraction, constipation, headache, and vomiting were also present, these being attributed by the author himself to meningeal irritation. In Case 24 vomiting, delirium, attacks of insensibility, and violent headache coexisted eleven months before extraction.

Case 25 showed violent vomiting and fever.

In Case 36 there were coexisting chills, with elevation of temperature; later on, however, vertigo and vomiting were again noticed without the above abnormal symptoms. The last attack was only two days before the appearance of one of the semicircular canals. Finally, at the post-mortem in Case 28, Schwartz discovered a small cerebellar abscess with firm walls, which had doubtless already formed at the beginning of the vertigo. Disturbances of equilibrium have been noticed exceptionally after exfoliation of the *sequestrum*. This is not due to the absence of the labyrinth, but rather to continued irritation of the centre of equilibrium. The following are examples of the same:

Case 18: After extraction, patient otherwise healthy, "but after violent exercise still a trace of vertigo." The

pronounced vertigo before exfoliation in this case was ascribed to meningeal irritation.

In Case 35 vertigo was noticeable afterwards only in the dark.

In my own case, No. 42, I thought I remarked a slight uncertainty in the gait with closed eyes, patient declaring himself, however, completely free from vertigo. In all of the remaining cases where disturbances of equilibrium were noted they disappeared entirely after elimination of the labyrinth.

In a single case (No. 20) pronounced disturbance of equilibrium and vertigo were first noticed after exfoliation of the labyrinth. This, however, was followed by further exfoliation, with coexisting frequent syncope, vomiting, and other constitutional symptoms indicating cerebral implication. Besides this there was a suppurative middle-ear process of the other side, with the formation of polypi, so that this case would not be taken into consideration here.

Subjective Noises.

I have subjected the histories of all of the forty-six cases to special scrutiny, and have only found three cases where subjective sounds were complained of. In my own five cases they were absent. The three cases are as follows:

1. (Toynbee, Bibl., Case 9.) Otorrhoea had here existed off and on for twenty years, becoming copious in the last two years. The more acute phenomena of inflammation began six months before the extraction of the sequestrum, and simultaneous with a more copious discharge there was violent pain of the side of the face implicated, with "a pulsation and noise like the puffing of a locomotive" in the diseased ear. A few days later a temporary facial paralysis made its appearance.

2. (Cassels, Bibl., No. 20.) A very loud noise was complained of in the last months before extraction of the sequestrum. A chronic suppuration of the middle ear existed on the opposite side.

3. (Jacoby, Bibl., 37.) In this case the discharge from the middle ear commenced eight months before the death of

the patient from phthisis, and was preceded by tinnitus and deafness by six or eight weeks. This, according to my experience, is often the case in otitis media purulenta phthisica; tinnitus and impairment of hearing here often preceding the perforation (mostly painless) and rapid decomposition of the drum-head. As soon as the middle-ear space is laid bare, necrosis takes place rapidly and almost without symptoms extending to the internal ear. According to this the process, which resulted in the partial elimination of the pars petrosa, had not commenced at the time tinnitus was reported.

In the cases of double exfoliation (Bibl., 13, 14) of the cochlea, Gruber inferred from the boys' confused statements that subjective noises were present. There are, therefore, only two cases among the forty-six in which the presence of subjective noises was demonstrated with certainty. In both cases the noises were noticed only before exfoliation, and in Toynbee's case were undoubtedly an initial symptom of extension of the suppuration to the labyrinth. Continuance or reappearance of the noises after the cessation of the necrosing processes is not reported in any of the cases, absence of the same being especially mentioned in some of them. That subjective noises are of rare occurrence in labyrinth necrosis, as is conclusively shown by my statistics, seems to me to be a not unimportant addition to our knowledge of the usual seat of these symptoms, which so tax the patience of both doctor and patient, and whose origin is still shrouded in a veil of mystery.

I remember that my never-to-be-forgotten teacher, von Graefe, in one of his lectures, once warned us against enucleation of the eye for the relief of photopsia in cases of amaurosis, as he was convinced that it often persisted unchanged after the operation, thus showing it to be of central origin. The organ of hearing, according to the conclusion arrived at above, does not seem to bear an analogous relation to that of sight in this respect. The atrophy of the acoustic nerve develops centripetally and would eventually involve the central organ itself; hence we might expect the occurrence of subjective noises, just as we expect

photopsy in certain cases of amaurosis. The complete absence of them, however, in a comparatively large number of cases, justifies us in the supposition that, unlike analogous phenomena in the eye, they have their origin, at least as a rule, in the labyrinth itself or its appendages, and in exceptional cases only are they due to disease of the more centrally located organs. The fact that this symptom is so seldom present at the beginning of the necrosing process leads us to think that the seat of the noises is more easily and rapidly destroyed than the end-distribution of the rami vestib. in the ampullæ, whose irritation, judging from the preceding destructions, would seem to cause the vertigo and disturbance of equilibrium.

Tests of the Hearing.

The result of the hearing tests requires also a somewhat more searching critique. It is quite natural to suppose that destruction of the peripheral organs of perception and complete loss of the function of hearing are inseparable companions; there are, however, some authors who have abandoned this hypothesis, which we thought so self-evident as a mathematical axiom. In our table the following facts are specified:

In seven cases a definite opinion as to the hearing could not be arrived at, partly owing to the youth of the patient, and partly because of the patient's drowsiness.

In eleven cases very indefinite notes are given. In Case 7, for instance, deafness is first reported, and later on hardness of hearing. In Case 31 the hearing was tested three weeks before the post-mortem (which showed complete demarcation of the labyrinth at least on the side towards the tympanum). The watch was not heard, but the tuning-fork upon the vertex was recognized with the diseased ear.

In Case 42, reported by myself, the tuning-fork a¹ was heard through the air several weeks before exfoliation; watch and gentle voice, however, were not perceived. I did not see the sequestrum myself in this case, but according to the declaration of the attending physician it was either a piece of the cochlea or a semicircular canal.

In twenty-three cases, four of them my own, complete deafness was observed.

In five cases there seemed still to be a greater or lesser capacity for hearing in the diseased ear after exfoliation of more or less of the labyrinth; in fact, in four cases of the cochlea itself. These are the following:

1. Case 17 (Guye). According to the reports of the "Ver-
sammlung der deutschen Naturf. und Aerzte," a child of five
years heard the watch at a distance of 2" to 4" after exfoliation of
a sequestrum containing the posterior half of the vestibule and
the semicircular canals. The hearing distance of the other ear
is not given.

2. Case 20 (Cassels). After exfoliation of the sequestrum,
consisting of the well-characterized cochlea (shown by Schwartz
in an illustration), the patient, two years old, heard the watch at
about 1", also words of one syllable at 16', and distinguished with
certainty all the notes on the scale of the piano: C' and C were
equally well heard through the bones of the head as at a dis-
tance of several inches; all this with the other ear thoroughly
occluded. About six and one half months before exfoliation the
watch was not heard when placed on the bone, and the tuning-
fork only slightly perceived, whilst loud conversation was heard
only when in the immediate vicinity. During the gradual elimi-
nation of the sequestrum on the side tested, there was an exist-
ing middle-ear suppuration with the formation of polypi on the
other side.

3. Case 35 (Christenneck). The patient, fifty-four years of
age, does not hear the tuning-fork c; three weeks after the re-
moval of the necrosed cochlea, with the corresponding resonator
on the vertex, however, he locates its tone in the affected ear;
three weeks before this he heard it equally well in both ears, when
placed on the vertex. On the other side the watch is heard at a
distance of 3 cm.

4. Case 38 (Jacobson). A week before death the twenty-nine-
year-old patient, whose right ear was normal, heard whispering
voice S near the ear, equally well by closed or open ear canal; c
most strongly struck, not heard; f''' sharp, at 8". c with bone-
conduction heard with diseased ear. The last was also reported on
the day of death. Upon post-mortem, the only remaining portion
of the cochlea was found to be a small necrotic piece of the
lamina spiralis.

5. Gruber's case, No. 39. After removal of the sequestrum containing the cochlea (shown by Gruber in an illustration) by means of the syringe, the patient, *aet.* fourteen years, hears watch when laid on jawbone or mastoid process (on right normal side watch perceived 145 cm). The sound produced by running the finger over the small ordinary tuning-fork is heard with the affected ear, as well as other tuning-forks; one of the same placed upon the finger occluding the diseased ear, was also heard by it; according to the statement of the patient, "moderately loud-spoken words are heard quite well with closed, right, normal ear, and with the aid of the ear-trumpet appreciates whispered conversation with the left ear, and repeats the words after me." A similar test by means of the voice with closed left ear-canal was not made.

These five positive results as obtained by the hearing tests, conflict decidedly with our physiological theories as to the special function of the end-distribution of the sensory nerves, and we have therefore every reason to be cautious in drawing any conclusion from them, especially so as to the statements of the patients themselves. Otherwise we would be compelled to invest the trunk of the acoustic nerve, which normally is only the path over which the impression travels, with the power of appreciation and reception of direct irritation. This would amount to just as much as supposing (and I think the analogy quite justifiable) the stump of the optic nerve after enucleation capable of receiving and transmitting impressions produced by the waves of light falling into the empty orbit. Luckily a disproportionately large number of cases with negative results stand in direct opposition to this.

In Guye's case, where the sequestrum embraced only the posterior half of the vestibule with the semicircular canals, there is perhaps a possibility that the terminal nerve twigs in the cochlea still partially preserved their function, notwithstanding the destructive process in the immediate vicinity. I can, however, hardly bring myself to accept this conclusion, as the *fenestra ovalis* must have been included in the destruction. In the other four cases it was the cochlea itself that suffered. While we do not believe

the cochlea the sole organ for the perception of sound (which conclusion, nevertheless, becomes more and more justifiable), we may, however, infer that in all probability the soft parts of the remaining labyrinth, as well as in the cochlea, were destroyed ; and this was shown at the post-mortem examination in Jacobson's case (No. 4), where a carious excavation, filled with granulations and cheesy matter, had taken the place of the labyrinth. The inference that the hearing is completely lost with destruction of the labyrinth, in my opinion, rests upon a more solid foundation than our hearing tests. For this reason it seems to me that the cases of labyrinth necrosis are more than usually valuable material, upon which the reliability of our approved tests of hearing themselves is to be verified, rather than the deduction of opposite conclusions, based upon doubtful results gotten from ears in which, although the cochlea is wanting, the power of hearing is still more or less present.

One of the principal sources of error in our tests of hearing is the difficulty and partial impossibility of the complete exclusion of the other ear from the act of hearing. The presence of the smallest opening in the auditory canal still suffices for the almost normal perception of sound. One may easily convince himself of the truth of this, in cases of inspissated cerumen, where the auditory canal is apparently completely occluded. Should there, nevertheless, be the smallest passage, however devious, or chink, however small, through which the waves of sound may pass, no very perceptible diminution of the hearing distance is obtained.

The slight influence of a narrowing of the auditory canal is especially noticeable in solitary exostoses, with broad bases.

I have at present such a case under observation, where the bony growth has so occluded the canal that the passage of a small probe is impossible ; more than this, the remaining chink is partially filled with epidermic scales, and the affected ear shows almost normal hearing. This remarkable fact is well known, and easily explained.

With the finger, it is just as it is with an exostosis. Although the forefinger in size and form is quite well adapted

to the complete occlusion of the entrance of the ear canal, a few hairs more or less thick, growing in the canal, may render it impossible to hermetically close it. Where this obstacle is not present, strong pressure with the finger is necessary to conform it exactly to the shape of the entrance to the meatus, and this, as may be demonstrated upon the cadaver with only moderate pressure, causes a strong movement of the *Mt* inwards, which imparts a sensation any thing but agreeable, as I can testify from personal experience.

Our tests of hearing, as universally practised, intrusting the occlusion of the ear not under examination to the patient himself, offer for this reason a very doubtful guaranty of the thorough exclusion of the other ear. Our experience has taught us that it is impossible to test the sight accurately if we allow the patient to obstruct the sight of one eye by covering it with his hand, as it is well known that he removes it when we ask him a question, thus disturbing the test and making a bandage over the eye necessary. The same is the case when we intrust the patient with the duty of thoroughly closing his ear. This element is so important that it threatens to overturn our fundamental physiological theories as to the function of the ear, as seen in the cases where, with the labyrinth missing, apparently positive results were obtained. The precaution should at least be taken of confiding the closing of the ear to a reliable assistant. Whether this was the case or not in the five cases cited is not mentioned. In addition to this, in making such tests the ear under examination should also be closed, as was done by Dennert and Lucae, in order to satisfy one's self that the other ear is really thoroughly excluded from the test. Further than this, perception of the majority of the sources of sound reaching our ears is not prevented by the complete hermetical sealing of the entrance to the ear canal. We may convince ourselves of this in the following simple manner: standing upon a stool in order to eliminate transmission through the floor, both ears being tightly closed with the forefinger, in spite of this we may hear every single note of the scale of the piano with facility; in fact, the

higher the note on the scale, the better it is heard. The same is experienced with medium loud conversation, which is heard at a considerable distance with both ears completely occluded. Distinctly enunciated whispering gives the same result, and it is only when one whispers with lessened impulse of expiration that the sound is extinguished. The safest and most adapted method for testing unilateral deafness is the use of the tuning-fork through the air. In the tuning-fork we have a sufficiently weak source of sound, owing to the fact that the tone is given off in a very slight degree, so that the other ear may be left entirely out of consideration, it not being even necessary to close the same, at least with the deeper tuning-forks. Nevertheless, we may increase the intensity of the tone by approaching the instrument close to the ear under examination.

Since the strength of the sound diminishes in reciprocal proportion to the square of the distance, the tuning-fork gives us a great advantage over the piano and the voice. Its branches may also be held directly in the concha.

The deeper-toned forks are the only ones adapted for this examination, and these must be as free as possible from high tones.

After this unavoidable general discussion, let us consider the above five cases somewhat more in detail, beginning with Guye's case, where the patient was only five years of age, and in addition to this was tested with the watch only, which, as we all know, is so apt to mislead, that I hardly think the results obtained in this case worthy of further consideration, in view of the important question involved.

In the third case, of Christenneck, the tuning-fork c was only heard when the "resonator" was used; hence bone-conduction in this case would not be excluded, for the powerful waves of sound originated in the resonator pass along its walls to the bone, and thence are transmitted to the normal ear upon the other side. The results obtained in this case by means of Weber's method may be also disregarded, as different results were obtained at different times. In Case 4, of Jacobson, the whispered voice, with both open and closed ear, was equally well heard—that is to say, quite

badly heard. Tuning-fork c sharp''' was heard 8" too short by the diseased ear. Since, however, the other ear was normal, this note, as well as the voice, would have been heard even with occlusion of the diseased ear (about which nothing is noted), as has already been discussed, as well as the uncertainty of the patient's statements in Weber's method. There remain, therefore, only the cases 2 and 5 of Cassels and Gruber. The fact that the patient understood words of one syllable spoken in a moderately loud voice, at a distance of sixteen feet, would not be positive evidence against deafness, since the moderately loud voice is still heard by the normal closed ear at a considerable distance; but, in addition to this, the watch was heard at one inch, and the tuning-forks C¹ and C, not only when placed upon the bones of the head, but also at a distance of several inches. This apparent improvement of the hearing distance in an ear from which the cochlea had been removed would seem the more remarkable when compared with the result obtained six and a half months before exfoliation, at which time the loud voice was only heard in the immediate vicinity. In order to interpret correctly the significance of these differences in the hearing at different periods of time, we must not lose sight of the fact that a suppurative polypous inflammation of the middle ear existed upon the other side, which is sufficient of itself to produce apparently great differences in the hearing capacity of the deaf ear. The statement that the patient heard all the notes of the scale distinctly, seems to me to be somewhat doubtful. It has also been mentioned above that this is possible with the completely closed ear. Schwartz himself, in presenting a translation of Cassels' case in the *Arch. für Ohrenh.*, does not hesitate in declaring the apparently positive result of the hearing tests to be a delusion.

As far as the last case (Gruber's) is concerned, the hearing of the watch when laid upon the jawbone and the mastoid process of the diseased side is to be disregarded, for the other, in this case normal, ear was not excluded, owing to the bone-conduction of young subjects. Also the perception of the tuning-fork placed upon the finger occluding the

diseased ear has little significance, for this method, recently recommended by Gruber, is simply a transmission by aerial and osteo-tympanal conduction combined, and does not exclude the other ear. The positive result of the test with the whispered voice is of little import, because of the absence of the counter-test with simultaneous closure of the diseased ear. The appreciation of the small a" tuning-fork through the air might seem the most remarkable of all. I have, however, with special reference to Gruber's case, tested one of my patients (Bibl., 44) with the same small tuning-fork in the manner mentioned, and obtained the same result as Gruber, although the hearing in this case was not even normal upon the other side, while the deeper tuning-forks, whispered voice, and the noise of Hedinger's acoumeter, when laid upon the diseased ear, were positively not heard in the slightest degree. The ear had shown itself absolutely deaf to all other tests. In my first case (Bibl., 42) the tuning-fork a¹ was apparently heard a month before exfoliation, although the ear was absolutely deaf to whispered conversation. A possible explanation of these strange phenomena might be given as follows: While the normal auditory canal is attuned to a much higher note lying in the four-marked octave, the considerable enlargement of the canal, due to its free communication with the middle-ear space, results in a much deeper tuning of it, and under this hypothesis the more powerful standing waves originating in the canal may pass on to the bone, and thereby be transmitted to the opposite ear. A certain and sure proof of the absolute deafness resulting from loss of the cochlea is only to be obtained in cases of bilateral exfoliation, and we are indebted to Gruber himself for the observation of such a one (Bibl., 13 and 14). In this case there was complete deafness upon both sides to the voice with the ear-trumpet, noises, musical instruments of all kinds, as well as the whistle and tuning-fork. Subsequently the patient, a boy of twelve years, became a deaf-mute.

Facial Paralyses.

The following are the results of the observations of the facial nerve:

In eleven cases, the histories of which are mostly very brief, there are no reports, or very unreliable ones, my own case (Bibl., 46) being included among these. As to the remaining thirty-five cases, incomplete implication of the facial nerve was observed in six cases only; in three of these the necrosis was limited to the cochlea exclusively, in one to the cochlea and a small portion of the vestibule; in a fifth, one of the semicircular canals was the sole lesion, while in the sixth case there was extensive caries of the labyrinth with exfoliation of the lamina spiralis, as shown by post-mortem.

In four cases with fatal issue before removal of the sequestrum the paralysis existed until death.

In one other case, also fatal, it was impossible, owing to the stupid condition of the patient at the time of the examination, to determine whether complete paralysis or only paresis existed. In two of these the post-mortem showed partial demarcation of the necrotic labyrinth; in one case, of the cochlea and other portions of the pars petrosa; in another, sequestration of the whole posterior section of the petrous portion was observed; while in the fifth case the cochlea, with a part of the carotid canal, was found lying in the external auditory canal.

In one case, where the only symptom was twitching of the muscles supplied by the facial, this happening two weeks before death, the post-mortem showed necrosis and partial exfoliation of the entire labyrinth together with the porus acust. int.

In three cases without fatal termination, the subsequent condition of the facial nerve is not mentioned, although complete facial paralysis existed during the period of exfoliation. In these three cases the sequestrum included once the entire apex of the pyramid with labyrinth and porus acusticus int., once the whole labyrinth, and thirdly the cochlea.

In four cases the paralysis was only a temporary manifestation, appearing during the process of exfoliation, and disappearing when the same was completed. In three of these the extruded sequestrum proved to be the cochlea, while in the fourth it was either a turn of the cochlea or a semicircular canal.

In six cases there was only partial recovery from the paralysis. Here the sequestrum in one case embraced the pars petrosa entire, with the external osseous ear canal and a part of the mastoid process; in another, a part of the pars petrosa with the semicircular canals and a portion of the mastoid process was verified; a third case included the whole of the labyrinth; while a fourth showed a part of the vestibule with the semicircular canals; finally, the last two were parts of the cochlea. In the ten cases remaining of the forty-six tabulated, it is distinctly mentioned that the facial paralysis persisted permanently after the elimination of the sequestrum. In the first of these the necrotic process attacked the upper part of the inner wall of the tympanum, taking in a part of the fenestra ovalis and the facial canal; in the second, the whole labyrinth, porus acust. int., and the posterior wall of the bony ear-canal were included; another showed a large piece of the pars petrosa with the labyrinth and pars mastoidea besides; a fourth was verified as the base of the cochlea alone; while a fifth embraced the cochlea with a large part of the inner vestibular wall, the porus acust. int., and the commencement of the canalis Fallop. In the five cases remaining, the sequestrum included the whole or portions of the labyrinth.

As is seen from this summary, in thirty-five cases of labyrinth necrosis, paralysis of the facial nerve existed in twenty-eight, while one case showed irritative disturbances only. The facial nerve was hence implicated in eighty-three per cent. of the cases, and *its involvement is therefore one of the most frequent symptoms of the presence of necrosis of the labyrinth.* The intimate connection between the canalis Fallop. for a great part of its course and the labyrinth explains very satisfactorily this frequent participation. The course of the facial nerve in the temporal bone may be divided into four sections, which lead to entirely different sequelæ, according as they are implicated in the exfoliation of different parts of the labyrinth. The first part of its course within the porus acust. int. was included in the morbid process in all those cases where exfoliation of the entire labyrinth resulted, the fundus of the canal being regularly attacked; in

fact, it is quite frequently mentioned that the whole or part of the porus acust. int. was included in the sequestrum. In eight out of the ten cases with permanent paralysis, the porus acust. int. was partially or totally included in the exfoliated sequestrum. This was also the case in three out of the six cases where partial recovery from the paralysis resulted. On the other hand, in the ten cases where the nerve was not affected, or the paralysis of temporary duration, no part of the porus acust. int. was included in the sequestrum, when we except the tractus foraminalementus, which was more or less extensively implicated. In my own case (No. 46), however, there was not a trace of paralysis in after years, notwithstanding that the sequestrum contained the whole of the por. acust. int. I shall refer to this case in detail later on.

The partial or total exfoliation of the porus acust. int. is followed, therefore, in the majority of cases by a permanent, partial, or complete loss of function of the auditory, as well as the facial nerve. This is, however, not the case with the second section of the path of the nerve, which extends from the beginning of the canalis Fallop. to its knee (only a few millimetres long). This part of it lies above the cochlea, and hence is not necessarily prejudiced by the destructive process; immediately after its passage from the internal meatus into the canalis Fallop. the nerve runs, however, directly over the superior portion of the first turn of the cochlea, and exfoliation of the same is very likely to be followed by simultaneous perforation into the facial nerve canal at this place, as the bony wall between is something less than one fourth of a millimetre thick. I have verified this measure upon a large number of my own preparations, and find it to be relatively constant.

In only one of the cited ten cases of permanent paralysis was the sequestrum composed of the cochlea alone, while two of the six cases of permanent paresis produced a sequestrum formed exclusively by the cochlea. On the other hand, the sequestrum in three of the cases of temporary paralysis included parts, or all, of the cochlea. (I have not added my own case, 42, to these, as I did not myself see the

fragment exfoliated. It was said to be a part of the cochlea.) In five of the six cases where paralysis was wanting, the cochlea was more or less implicated, the necrotic process in the sixth being limited to one of the semicircular canals.

In spite, therefore, of the immediate neighborhood of the facial to the morbid process, permanent disturbance of its function is the exception in necrosis of the cochlea, and in most cases its elimination of the cochlea is attended with temporary disturbance only, or none at all; a conclusion which Schwartze has already arrived at, though with a smaller number of cases.¹

The facial nerve is in more danger when it enters the third section of its course, extending from the knee horizontally backwards, at first over the median wall of the bony tube, and then along the internal wall of the tympanum, to the point where it bends a second time to pass down in a vertical direction. As far as the relation of this tract to the cochlea is concerned, however, when the sequestration is not extensive, it is better protected than the first part of the commencement of the canal. Fallop., being above the cochlea and farther away from it than the latter. Elimination of the cochlea may then occur without perforation of any part of the canal, except the very first part of section two, described above as being only separated from the cochlea by a very thin shell of bone. Necrosis of the labyrinth, on the contrary, is much more dangerous to the third section of the canal; exfoliation of the bony vestibular walls, especially with implication of the semicircular canals, if only their beginning, being simply impossible without division or involvement of a greater part of the canal in the necrotic process. This is at least true of the majority of cases where exit is found through the tympanum and auditory canal, avoidance of the canal being only possible in those exceptional cases in which the sequestrum passes through the mastoid antrum with secondary necrosis of the pars mastoidea and the formation of an external fistulous opening. Corresponding to this, we find in seven of the ten

¹ *Arch. f. Ohrenheilk.*, Band xii., page 120.

cases of permanent paralysis cited, complete exfoliation of the entire labyrinth, with partial implication of other parts of the petrous bone; in another case, a larger part of the inner vestibular wall extruded; while still another involved the cochlea alone, the tenth and last case having attacked the facial canal itself, including a part of the *fenestra ovalis*. Moreover, in direct opposition to this, in none of the six cases where the integrity of the facial was preserved, is extensive necrosis of the vestibule or semicircular canals reported, the process in four of the cases being limited to the cochlea, in one to the cochlea including a small portion of the vestibule, and in the last to one of the semicircular canals. Necrosis of the whole of the labyrinth is, therefore, followed by permanent paralysis. (There are also exceptions to this rule, as will be seen further on.) Passing, finally, to the consideration of the fourth section of the Fallopian canal, extending from its second turn to the foramen stylomastoid., we find that it is seldom exposed to primary destruction by demarcation of the labyrinth, but may be affected secondarily, especially when the sequestrum makes its exit through the mastoid antrum. This is, of course, also possible when the necrosis extends from the labyrinth to the posterior tympanal wall and central parts of the mastoid cells, or implicates the posterior wall of the osseous auditory canal; as happened in two of the permanent paralysis cases, and also in two with subsequent permanent paresis.

At the post-mortem in Case 31 (see Bibliography), Schwartze found that the trunk of the facial nerve between the knee and the second bend had been squeezed flat by the granulations surrounding the sequestrum. It is thus seen that although the nerve may not be pressed upon or torn by the passage of the sequestrum itself, the pressure exerted by the granulations developing in its line of demarcation is quite sufficient to completely interrupt the conduction of nerve impulses.

It is a well-known fact that temporary paralysis and paresis of the facial nerve is caused every now and then by extension of an old putrid suppuration of the middle ear of years' standing, through a pre-existing or newly formed

opening in the facial canal, at any point of its course through the temporal bone. A series of such cases has been reported in H. Tillmanns' dissertation.¹ I would, however, emphasize the fact that this temporary paralysis produced by simple middle-ear suppuration without destruction of the bone, or even by acute catarrh of the middle ear, is of very rare occurrence. In support of this I find that in 850 cases of suppuration of the middle ear, noted in my last three-yearly report,² only 9 developed facial paralysis; 227 of the above cases were acute, while 623 were chronic, including formation of polypi, caries, necrosis, cholesteatoma, and otitis media purulenta phthisica. I can answer for the correctness of this statement, as it is my habit to inspect the patients myself at the time of their reception, for the purpose of establishing the diagnosis. The frequency of facial paralysis in purulent suppuration of the middle ear is hence to be rated at a little over one per cent. Two of these nine cases are included in the table of labyrinth necrosis (Cases 42 and 43).

In the third case, reported elsewhere,³ the permanent facial paralysis in the 1½ year-old lucid child was due to necrosis of the whole annulus tympanicus, which was removed by operative procedure. The fourth case was a phthisical woman in whom the characteristic otitis media purulenta appeared in the right ear one year before death. She presented herself for treatment six months after this, at which time the *Mt* was already totally destroyed with loss of hearing. This was followed subsequently by exfoliation of hammer and anvil.

Facial paralysis developed two months before death, beginning with fibrillar twitchings throughout the muscular distribution of the facial, these disappearing nine days later from the orbicularis with resulting lagophthalmus, but persisting thirteen days longer around the mouth and chin, from which time on complete paralysis of the entire muscular distribution was established, which persisted until death.

Post-mortem showed extensive caries necrotica with perforation

¹ Halle, 1869.

² *Arch. f. Ohrenheilk.*, Bd. xxi., p. 221.

³ *Münchener med. Wochenschr.*, No. 49, 1884.

of that portion of the canalis Fallopiæ running through the tympanum, this canal being found quite empty as far as the probe reached. (I hope to give a complete report of the post-mortem in a later article.)

In the fifth case a discharge had existed for three years after scarlet-fever, with proliferation of the tympanic cavity and total destruction of the *Mt.* The facial paralysis has persisted permanently, accompanied with continuous fibrillar twitchings throughout the entire muscular distribution. The affected ear hears the low voice at 10 cm.

In Case 6, bilateral suppuration of middle ear had existed since childhood. Three days after the appearance of facial paralysis, the ear canal of the same side was filled with a large polypus, the removal of which was followed by considerable pain during the next few days following. The loud voice not heard with certainty with this ear. I did not see the patient again.

In Cases 7 and 8, acute exacerbations of suppuration with perforation of the membrana flacc. Shrapnelli had happened. Paresis and paralysis in both of these cases existed for a short time only, with complete recovery.

The ninth case is the only one where there is a probability of the paralysis having been caused by simple acute middle-ear suppuration. The five-year-old boy had had measles three weeks before, with appearance of R. facial paresis a week after recovery. Upon examination : R., otitis med. purulent. acuta ; L., otit. med. catarrh. acuta ; H D—R., $\frac{2}{3}$ metres ; L., low voice, $1\frac{1}{2}$ metres. In the majority of the cases, the pus was extremely foetid.

I do not remember to have seen paralysis or paresis in cases of simple, non-purulent acute middle-ear catarrh. Among the cases of facial paralysis with middle-ear affection, tabulated by Tillmanns, are also present a number of caries, phthisis, etc., the long duration of suppuration in some of them indicating extensive ravages. The great capacity of resistance to destructive influences, shown by the facial nerve, is also verified by the post-mortem observations of Voltolini,¹ Gruber,² and Kessler,³ where, notwithstanding the nerve lay free, owing to destruction of its

¹ *Virchow's Arch.*, Bd. xviii., p. 45, and Bd. xxxi., p. 219.

² Text-book, p. 540.

³ *Arch. f. Ohrenheilk.*, Bd. xviii., p. 26.

canal, no disturbance of its function was noticeable during life.

In every case of facial paralysis accompanying long-continued suppuration of the middle ear, we are therefore justified in excluding simple superficial suppuration, and in assuming the existence of extensive destruction of the bone, in most instances of the labyrinth.

Regenerative Capacity of the Facial Nerve.

Highly interesting deductions result from several of the histories given in the preceding pages, as to the regenerative capacity of the facial nerve. There is hardly another physiological fact that has been so clearly proven by numerous anatomical, histological, and experimental physiological researches, as well as by clinical observation, as the capacity for regeneration of nerve tissue after solution of continuity,—so much so that he who wishes to penetrate further into the depths of this question, is almost frightened by the mountains of literature that confront him. The functional results of nerve division at least rest upon a firm basis, most observers being agreed that simple division, or loss of substance, is followed by regeneration in the course of weeks or months, according to the conditions present, and provided the loss of substance does not exceed certain limits; also that the duration of this process is longer with the larger nerves than with smaller ones. The extraordinary power of regeneration of nerve tissue has also been shown by a series of other experiments, and also by surgical observations, as, for instance, the healing together of two entirely different nerves, or the successful transplantation of a piece of another nerve in the breach caused by the loss of substance, as where a piece of the sciatic of the rabbit was successfully transplanted in the course of the same nerve in the hen. H. Tillmanns, in his recent work "Ueber die Operative Behandlung von Substanz-verlusten an peripheren Nerven,"¹ tabulates a series of these remarkable results, with supplementary surgical observations by Notta, Langenbeck, and Hüber, as well as Sapolini, in which, in

¹ *Arch. f. klin. Chirurgie*, von Langenbeck, Bd. xxxv., Heft 4, page 923.

spite of a traumatic breach of continuity with substance loss of the brachial plexus and radial nerve, amounting to from 5 to 7 cm, complete restoration of function finally followed. Basing our supposition upon these observations, we may well conclude that the regenerative capacity of peripheral nerves is almost unlimited. There is, however, not so much unity as regards the histological aspect, and almost every possible theory finds a representative.

Returning to our consideration of facial paralysis in labyrinth necrosis, we find several cases among the forty-six tabulated, where partial or total restoration of the function of the facial, in spite of its division, is not to be doubted. In the six cases in which the facial paralysis was partially recovered from, the sequestrum included, in one case, the whole of the petrous bone, the external osseous ear-canal and a part of the mastoid process (Case 33); in another, a part of the pars petrosa, with the semicircular canals and a part of the mastoid process (Case 34); still another embraced the whole of the labyrinth (Case 40); while the fifth showed a part of the vestibule together with the semicircular canals (Case 17).

By far the most remarkable of all, however, was No. 5 of my own cases (Stirnweiss), where the *facialis* function was completely intact in spite of the fact that the *canalis Fallopiae* in its entire length was included in the sequestrum exfoliated six years before. Unfortunately, the not very intelligent patient is unable to say whether facial paralysis had existed or not. She does not remember that a peculiar appearance of her face was ever remarked by herself or her relatives. A single glance at the accompanying plate depicting the sequestrum can, however, hardly fail to convince us that this could not possibly have been absent. [See Fig. IV., *a.* and *b.*] If the long canal had only been partially disturbed by the suppuration, so as to represent a semicircular groove or channel, the gradual passage of the sequestrum might possibly have occurred without causing a solution of continuity. The *facialis*-canal, however, as seen in the sequestrum, is completely preserved as such, in its entire integrity, extending from its entrance into the internal

meatus to the middle of the *fenestra ovalis*, a semicircular groove such as before mentioned being only seen at the vertical portion of the canal after its second bend. A softening and subsequent tearing of the nerve, more probably, however, extensive destruction of it, must undoubtedly have taken place. The fact that the patient did not notice the facial paralysis, would lead us to think that exfoliation took place at an early age, the *sequestrum*, remaining in the roomy cloaca for years until it finally made its appearance in the auditory canal. Judging from the result of this case we may expect, under especially favorable circumstances, complete restoration, not only in simple division, but also where there is a considerable loss of the substance, of the facial nerve. The favorable conditions above referred to are, in the first place, the closest adaptation possible of central and peripheral ends of the nerve; next, owing to the irregular, crooked, S-shaped form of the canal, the more the canal loses in length the easier is the adaptation of the free ends of the nerve floating in the tympanal cavity, and the greater are the chances for compensation of the loss of substance by means of simple extension of the nerve. According to Tillmanns, it is most important to prevent the interposition of connective tissue between the free ends. He also calls attention to the fact that Vulpian and Philippeaux assert that in nerve transplantation the foreign nerve matter merely acts as a guide or conductor for the new-formed nerve fibres. This theory is supported by Vaulair's experiment, mentioned by the same author, where a piece 3 cm long was cut out of the sciatic nerve of a dog, and the nerve stumps then sewed to both ends of a decalcified bone cylinder 4 cm in length. At the end of four months the nerve was extirpated, and the loss of substance was found replaced by new nerve fibres. The conditions present in the tympanum may be compared, to a certain extent, with Vaulair's experimental arrangement. The nerve, with more or less implication of its substance, rests upon the granulations springing from the gap in the petrous bone, or is partially surrounded by the growth of the same. As soon as exfoliation of the *sequestrum* takes

place, it has been observed that rapid retrogression obtains of the proliferous growth in the tympanum. The nerve stumps, therefore, find themselves lying upon a cushion of granulations in a sort of cavity formed for their passage, and there is nothing to prevent their union, unless the direction of their ends is totally different. It seems to me that this is therapeutically not without importance. Of course it is not possible to sew the ends together in the tympanum, for this would indeed be ideal surgery. We might, however, in some cases succeed in recognizing extreme dislocation of the ends of the nerve, and correct it by changing their position. Further than this, could we but divine the points at which the nerve substance was missing, it would, of course, be important to remove obstructing granulations by means of the snare. Cases might possibly fall into our hands in which all this were technically feasible; I have therefore adverted to this possibility, that it may be taken advantage of, should such an opportunity present itself.

Physiological Deductions from the Regenerative Capacity of the Facial Nerve.

The possibility of complete reëstablishment of function of the whole muscular distribution of the divided facial nerve, as verified by the cases cited, seems to me physiologically important as regards the question of a more exact localization in the cerebral cortex. The muscular distribution of the *facialis* is scattered over a pretty considerable surface, while, on the other hand, its motor centres in the cortical substance are found in different parts of the brain, as is shown in central paralysis, which mostly affects the lower branches of the nerve, leaving the orbital region unmolested. The following interesting question hence presents itself: How is it possible to so establish a complete connection between a so widely scattered peripheral distribution and the equally well dispersed motor centres appertaining to it that the different muscle-groups are once more controlled by their appropriate centres acting under the influence of the will, in spite of a preëxisting extensive interruption of the nerve trunk? Even with the most complete

coaptation possible of the severed ends, it is hardly conceivable that the axis-cylinders would meet each other so exactly, or, following the nerve and its ramifications, would so reach its special muscular region, as to reëstablish precisely the primitive relation existing between centre and peripheral distribution. It would, for instance, be quite possible for the central part destined to communicate with the upper facial region, to connect with fibres to the lower part of the face, and *vice versa*. This is exactly what happened in one of my own cases (No. 2, Rieger), who had remained a month and a half under my treatment with unchanged facial paralysis. When I saw her again, two years after extraction of the cochlea, the paralysis had partially disappeared, so much so that, with the features at rest, no trace of the former affection was perceptible. In the meantime, however, involuntary twitchings of the different muscle-groups, repeating themselves at frequent intervals, had become noticeable. The patient can move the corner of the mouth strongly in the lateral or upward direction, *not, however, when he is told to do so, but when he is asked to shut his eye*. When he tries to shut his eye the orbicularis oculi remains immovable, while the muscles of the angle of the mouth act powerfully. This observation, in my opinion, proves conclusively that a connection had taken place between the centre for the orbicularis palpeb. and the peripheral branches supplying the corner of the mouth. In spite of this, we do not consider complete restitution of the *facialis* function impossible in this case, in the course of years, as happened in the case of the woman Stirnweiss. As the whole of the canalis Fallopiæ was exfoliated in the latter case, perfect coaptation is not conceivable, and hence there is nothing left us but the superposition of a gradual exchange of function between the implicated centres of the cortical substance, and also that the impulses of the mind start from other than their original locations.

The two cases of Rieger and Stirnweiss may perhaps be regarded as different stages of the same process of regeneration, which only reaches its completion with the lapse of time.

Condition of the Chorda Tympani and N. Petrosus Superficialis Major.

I shall give these only a passing consideration, referring the reader to the histories of the cases for more minute information. In one of the cases observed by myself I did not test the chorda-function (see history, Case 1). In another, owing to the youth of the patient, it was not to be obtained (Case 4). In my case No. 2 (Rieger) the patient's statements were so uncertain that I could arrive at no definite result (the test was undertaken at the time when the regeneration had already commenced). In another case (see history, No. 3, Blaim), complete anæsthesia of the chorda existed, together with total facial paralysis. In Stirnweiss' case (see history, No. 5) the function of both chorda and facialis was re-established after years, though both had been interrupted at first. Implication of the chorda is only positively reported twice (Bibliography, 5 and 25) by the other observers. As the loss of its function is usually not noticed by the patient himself, testing of the same seems only to have been undertaken exceptionally.

As the chorda not only accompanies the facialis for the whole of its path through the temporal bone (if we agree with Sapolini's observations, lately confirmed by Schulte¹), but also retraverses the tympanic cavity by a not much shorter way, it is divided in all cases in which the elimination and passage of the sequestrum leads to solution of continuity of the facialis. It is, in addition to this, in its isolated passage across the tympanum frequently exposed to the influence of suppuration, granulation, and especially to direct violence from the passage of the sequestrum through the middle-ear space. It is hence quite reasonable to suppose that the chorda is more often injured than the facial nerve in cases of labyrinth necrosis. If I may be permitted to draw conclusions from the small number of cases observed by me, I think the regenerative capacity of the chorda quite analogous to that of the N. facialis, keeping pace with the same. Implication of the N. petr.

¹ *Zeitschr. f. Ohrenheilk.*, Bd. xv., page 67.

sup. major—namely, drawing of the uvula toward the healthy side—is mentioned only three times by otologists (Bibl., 25, 35, and 39). In my own observations in the two cases of total permanent paralysis, it remained unaffected. As this nerve only accompanies the *facialis* as far as the very first part of the *canalis Fallop.*, which is least in danger as compared to the rest of the canal, its non-implication is anatomically quite comprehensible.

Case 4 deserves short mention (see history, my own cases), owing to the deviation of the tongue when stretched forth towards the paralyzed side, as ordinarily this is not seen in facial paralysis. An explanation of this is perhaps given in the supply of the *M. stylohyoideus* by a branch from the *N. facialis*, with perhaps an abnormal deviation in the direction of contraction of the muscle itself. The lack of symmetry in the development of the sides of the tongue, towards the point, noticed in Stirnweiss' case is inexplicable to me, the right half of the tongue corresponding to the paralysis showing a gradual diminution toward its point. Although the *chorda* proved to be perfectly intact in after years, its continuity, as well as that of the *facialis*, must have been interrupted for a long time. Whether a permanent degeneration of trophic fibres is also here to be accepted, is a problem I am not able to solve.

Extent of the Destructive Process of the Bone.

This subject has already been touched upon in the chapter on facial paralysis; there only remains, therefore, the somewhat more exact consideration of that region of the temporal bone which is most often the seat of the necrotic process—namely, the *pars mastoidea*. The same was implicated in twenty-two of the cases resulting in cure, and in five of the nine with fatal issue, that is in 58.7 % of all the cases, and gave partial indication for operative procedures.

In the 22 cases ending in recovery 7 showed simple tenderness on pressure (Bibl., 7, 9, 12, 13, 35, 39, 44), 8 abscess behind ear, with spontaneous formation of fistulous opening (Bibl., 5, 14, 16, 19, 33, 34, 41, 46), 2 (Bibl., 24 and 29) in which Wilde's incision was performed, and 5 in which per-

foration of the mastoid process, or artificial enlargement of an existing fistulous opening, was thought necessary (Bibl., 17, 26, 30, 40 and 45).

The five fatal cases showed *twice* (Bibl., 37 and 38) swelling and mastoid tenderness, *once* (Bibl., 19) spontaneous perforation of the external wall with passage of the sequestrum, and *twice* (Bibl., 28, 31) enlargement of fistulæ, and in the latter case, eight years before, scooping out of the mastoid process. Simple mastoid tenderness and swelling is much more significant when complicating a chronic otorrhœa of many years' standing, than when noted in the course of an otitis med. pur. acuta where it often disappears as rapidly as it develops. An example of the diagnostic worth of this symptom is offered in Case 38, where, at the post-mortem, thrombo-phlebitis of the bulbus ven. jugularis was found. Opportunity was hence given in the accompanying bibliography for the consideration of this partially subjective phenomenon. I would like further to call attention to the presence of cholesteatomatous masses in the coalescing cavities within the temporal bone, in two of my five cases. In only one of the other cases was this observed and the removal of the masses by artificial means noted. (Schwartz.) I am convinced that these masses are more frequent in bony necrosis than our statistics would lead us to suspect, for on the one hand they are found very frequently at the post-mortem in subjects where, as in so many cases of labyrinth necrosis, the suppuration has been going on for years (perhaps they are a factor in the origin of the necrosis itself). On the other hand, after exfoliation of the sequestrum the healing process in the resulting cavity often manifests itself by an epidermoidal metamorphosis which prepares the ground for the collection and retention of cholesteatomatous masses, as exemplified in Frau Stirnweiss' case.

Prognosis and Sequelæ.

As already repeatedly mentioned 19.6 % of 46 cases resulted in death (nine cases). Omitting the two phthisical patients, one of whom (Bibl., 19) died from his constitutional disease, while death in the other (Bibl., 37) was the result of extension of the destructive process to the base

of the brain, reduces the number of deaths to 7, or 15.2 %. In the majority of these cases death followed implication of the neighboring meningeal and cerebral regions, extension of the suppurative process taking place from the posterior surface of the pyramid, corresponding to the position of porus acust. int. The cerebellum was most frequently involved. Post-mortem showed cerebellar abscess in Cases 6, 9, and 28. In the case of phthisis (Bibl., 39) a blackish softening was found at the base of the middle lobe, which had resulted from perforation of the anterior surface of the pyramid. One case (Bibl., 31) showed lepto-meningitis, while in Case 6 death was caused by simple inflammation of the brain. In Case 10 delirium was noted before death, and finally in Case 38 septic phlebitis of the bulbus ven. jug. with pyæmia was demonstrated. In the case of fresh cerebellar abscess (Bibl., 28) there were found traces of old phlebitis and obliteration of the transverse sinus. The terminations of the 37 cases without fatal issue were as follows: In 29 cases the sequestrum was removed from the auditory canal, while in 7 cases it was extracted through fistulæ in the pars mastoid., previous artificial widening of the same being necessary in some of the cases. In the remaining case the sequestrum, according to Schwartz, passed through the tube. In 18 of the cured cases the discharge discontinued a few weeks or months after removal of the sequestrum, its permanent disappearance being verified from time to time subsequently. In 5 cases the otorrhœa persisted but was less copious. In one case constriction, and in another atresia of the bony meatus was noticed after loss of the posterior wall of the ear canal. In the first case (Bibl., 38) the discharge was insignificant, while in the latter (Bibl., 45) it had already ceased before the obliteration ensued, and I am hence not apprehensive of future trouble with either of them. Nothing is communicated as to the otorrhœa in the remaining 14 cases.

When we consider the concealed position and dangerous proximity of the suppuration to important parts, together with the therapeutic inaccessibility and long duration of the destructive process, not forgetting the dangers to the constitution at large, and difficulty of elimination of the

sequestrum, the prognosis seems unexpectedly good even as far as complete cure is concerned, as has already been stated by earlier authors. As already mentioned, there is also a very strong possibility of complete restoration of the function of the divided *N. facialis* even where an extensive loss of substance exists.

Treatment.

The therapeutic indications may be summed up in a few words, the treatment being about the same as in necrosis of the temporal bone. The most important point is the removal of the luxuriant proliferations obstructing the passage of the sequestrum through the tympanum and ear canal. The sequestrum is surrounded by granulations on all sides, and it is hence our duty to support the tendency to their growth behind it, thus constituting a *vis a tergo*, while we remove the granulations and polypi accumulating in front of it as completely as possible, thus allowing the pressure of the granulations from behind to exert its full influence. The most appropriate instrument for the removal of these proliferations is Wilde's snare. After removal of the sequestrum, further involution is favored by the introduction of alcohol by Politzer's method. Strict antisepsis, as in all suppurative processes of the middle ear, is absolutely necessary. In cases where there is no implication of the mastoid bone, and where the sequestrum is supposedly small enough to admit of its passage through the auditory canal, no other therapeutic measures are necessary than those above indicated. In order to fulfil the last-named indication I have used boracic acid, and have been convinced by its efficacy in these severe cases, that the objections to its use (*i. e.*, its causing retention of the secretion), as advocated by Schwartz and some of his pupils, are entirely without foundation. According to my experience, extending over a period of eight years, its use has always been followed by favorable and satisfactory results, so much so that I see no reason to modify my statements made in 1870 in Band xv. of the *Arch. für Ohrenheilkunde*, and in the *Aerztliches Intelligenzblatt*, 1881, No. 26, as to its therapeutic value. I have also confirmed my opinion of the unreasonableness of these objections, by a series of

physiological experiments in which I tested the capacity of absorption of powdered boracic acid for fluids, outside of the body, before as well as after saturation and drying out of the powder, with purulent secretion, which, enclosed in a glass tube covered with a perforated membrane, was exposed to the influence of fluids.

More thorough measures are necessary when the mastoid process is implicated. As soon as elevation of the periosteum exists, or fistulæ show themselves, an opening into the antrum should be made in the former case, or enlargement of the existing fistulous openings in the latter, with removal of the sequestrum. If the sequestrum is too large to admit of its removal in this way, excision of the posterior wall of the osseous ear-canal is indicated. This part of the auditory canal is not infrequently found to be also in a necrotic condition. Another indication for opening the antrum of the mastoid bone is given in such chronic cases where simple mastoid tenderness does not disappear after long-continued antiseptic treatment. After-treatment consists in the primary introduction of a rubber drainage tube, subsequently substituting one of lead, and the frequent washing out with a 1% solution of carbolic acid with an iodoform bandage. Granulations in the tympanum and ear canal are to be carefully snared off, while the wound and antrum are to be scooped out with the sharp curette when proliferous growths are remarked therein.

Explanation of the Heliotype plates.

Fig. I. *a* and *b*, lower turn of the cochlea, *a* seen from without, *b* from within; *c* and *d*, two more small fragments of bone, the first of which is recognized as belonging to the cochlea. (See history of case No. 2, Rieger.)

Fig. II. Lower and middle turns of the cochlea, *a* seen from without, *b* from within. (See history No. 3.)

Fig. III. Lower and middle turn of the cochlea, with a large part of the vestibule and the porus acust. int., *a* seen from without, *b* from within. (See history No. 4.)

Fig. IV. Sequestrum embracing the whole labyrinth and canalis Fallop., *a* seen from without, *b*, from within. (Case No. 5, Stirnweiss.)

REPORT ON THE PROGRESS OF OTOTOLOGY
DURING THE FIRST HALF OF THE
YEAR 1887.

A.—NORMAL AND PATHOLOGICAL ANATOMY, HIS-
TOLOGY, AND PHYSIOLOGY.

BY A. BARTH, OF BERLIN.

Translated by Dr. MAX TOEPLITZ, of New York.

I.—ANATOMY.

a.—HEARING ORGAN.

1. Dr. G. GRADENIGO, of Padua. The embryonic rudiment of the middle ear and the morphological significance of the ossicles. With five plates. (From Prof. SCHENK's laboratory in Vienna.) *Wiener med. Fahrh.*, 1887, p. 61. Reprint.
2. Dr. W. KIESSELBACH, of Erlangen. Contribution to the histology of aural polypi. *Monatsschr. f. Ohrenheilk.*, etc., 1887, No. 4. Reprint.
3. Dr. HERMANN BULLE, Cuxhaven. Contributions to the anatomy of the ear. With one plate. (From the Anatomical Institute at Rostock.) *Arch. f. mikroskop. Anat.*, vol. xxix., p. 237.
4. Dr. KIESSELBACH, of Erlangen. Saw-section for the opening the entire facial canal. *Monatsschr. f. Ohrenheilk.*, etc., 1887, p. 33.
5. G. SCHWALBE. Contributions to the knowledge of the circulation in the cochlea. With one plate. Reprint from *Contributions to Physiology*; dedicated to Carl Ludwig by his pupils. Published by Vogel, Leipsic.

6. Dr. JULIUS WALDSCHMIDT. Contributions to the anatomy of the brain of deaf-mutes. With one plate. (From the Anatom. Institut. of the University of Freiburg.) *Allgem. Zeitschr. f. Psych.*, vol. xliii., p. 373.

7. Dr. v. MONAKOW. On the origin and the central course of the acoustic nerve. Lecture delivered November 11, 1886. *Correspondenzbl. f. Schweizer Aertze*, 1887, No. 5. (Revised by MONAKOW in the *Neurol. Centralbl.*, 1887, p. 201.)

8. Dr. L. EDINGER, of Frankfort-a.-M. Comparative embryological studies of the anatomy of the brain and of the connection of the sensory nerves with the intermediary brain. With five drawings. *Anatom. Anzeiger*, 1887, No. 6. Reprint.

9. Prof. W. BECHTEREW, of Kaşan. On the question of the origin of the acoustic nerve and on the physiological significance of the N. vestibularis. *Neurolog. Centralbl.*, 1887, p. 193.

1. On account of the neglect with which the anatomy of the middle ear has been treated when compared to the care awarded to the inner ear, GRADENIGO has devoted his time to these studies, for which every one who takes interest in the anatomy of the ear will be grateful to him. It is, of course, impossible to dwell here upon the details of the examinations and results attained by the author, who has also made careful use of the literature. We highly recommend the paper to the thorough study of our readers, though we can draw attention only to a few points contained in it.

The hammer and anvil may be considered as derivatives from the first pharyngeal arch. The stapes of man and of the higher developed mammals arises from two distinct morphological elements, namely, the stapedial ring from the second pharyngeal arch and the stapedial lamina from the labyrinthian capsule. The lower jaw, the squamous bone, the tympanic ring, and the processus gracilis mallei may be considered as cover-bones of the mandibular cartilage. The first phase of development represents in a measure a regressive process; in the second phase, as soon as the definite forms of the skeleton parts have been approximately reached, the tubo-tympanic space begins to extend. The tympanic cavity first extends around the handle of the malleus and the reflected part of the musc. tensor, then it is prolonged backward along the future membr. typ., and reaches the posterior margin of the tympanic ring. The mesoblastic tissue around the long process of the anvil, around the stapes, and near both labyrinthian windows disappears last.

2. KIESSELBACH divides the aural polypi into : (1) round-cell polypi (granulation tumors) ; (2) mucous polypi (fibromata with areolar structure and mucinous intercellular substance) ; (3) myxomata ; and (4) fibromata. He has seen a polypus which originated at the transition between the auditory meatus and the middle ear, and was covered with cylindrical epithelium and smooth epidermis. In two polypi he found cysts covered with the most different forms of epithelium varying from the pavement to the ciliated, which latter consisted of several layers.

3. The examined material consisted of petrous bones of man—adults and foetus,—of rats, rabbits, guinea-pigs, and cats. The paper is divided into four parts : (1) upon form, (2) upon epithelium, (3) upon glands of the tympanic cavity, and (4) upon the gland-like appendices of the sacculus. As nothing important can be said about the remarks upon the form, we proceed immediately to the second point. The ciliated epithelium of the Eustachian tube extends along the external wall and along the lateral part of the upper wall to the margin of the membrana tympani ; the inner and lower wall is covered with pavement epithelium, the membrana tympani itself being covered only with single-layered pavement epithelium, so also the osseous walls in the direction from the centre of the *Mt* backward, but sometimes swells at the latter region to cubic form. The ciliated flat cells must be considered transition forms. This relationship in man is also generally found in animals, but in a more irregular manner. In depressed parts higher, often ciliated epithelium is generally found ; in very prominent places nothing but low epithelium. The two-layered epithelium of former embryonic stages is changed later to ciliated of one layer. Gland-like formations could not be found by the author in the posterior region of the tympanic cavity, but farther in front. After careful consideration of their form they are found not to be glands, but "crypts" of the tympanic cavity. The mucous secretion in the middle ear is not affected by certain glands, but by the entire surface of the mucous membrane. Finally gland-like hollow projections in the sacculus of the embryo are mentioned, which are considered equivalent to the projections in the aquæduct already described by others, but their morphological importance can be only surmised.¹

4. KESSELBACH describes a section which exposes, in addition

¹ Apparently an extract from the dissertation : "Contributions to the Anatomy of the Ear." Rostock, 1886. The latter was not at my disposal.—REVIEWER.

to the entire facial canal, and the openings of the accessory canals, the transition to the antrum, the lower part of the vestibule with the foramen ovale and the commencement of the cochlea, as also the point of entrance of the auditory nerve; the posterior part of the section exposes the situation of the antrum mastoideum, and the lower part of the vestibule with the semicircular canals.

5. SCHWALBE gives a clear description of the arrangement of the blood-vessels in the cochlea of the guinea-pig, which comprises much that is new, many facts which until now were only partially known, and the main points of which will certainly be agreed to by all anatomists. The central canal of the modiolus does not represent a straightly stretched and regular cone, but is turned around its axis, so that the surface is alternately elevated and depressed, the form of the canal thus resembling a screw. Rarefied and thickened spots are thereby formed in the osseous mantle of the modiolus, which are pierced in a distinct alternation by nerves and vessels. Nothing is more striking in an axial section of the cochlea than the spirally turned trunk of the acoustic nerve, which forms the well-known ganglionic enlargement on its course to the lamina spiralis. Always between two exits of nerves there remains between nerve-trunk and osseous (vestibular) wall of the modiolus a space filled with loose connective tissue, the "tractus spiralis arteriosus," in which the larger arteries springing from the cochlear artery take their course. The further arrangement of the blood-vessels is minutely described.

6. Having the opportunity of examining two brains of deaf-mutes, the author found in both concordantly a striking rudimentary development of the islands of REIL on the left side, especially of the parts situated frontally. Upon trying to explain these anatomical relations he points to the fact that the centres of speech and hearing do not need to be degenerated, but that a (partial) interruption of conduction suffices to affect the inhibition.

7. The author had previously shown that in ablation of the hearing sphere of the cortex in cats, this centre is shown to be in connection with the corresponding corpus geniculatum internum and the brachium conjunctivum posticum (perhaps also with the corpora quadrigemina posteriora). The removal of a part of the cortex from the right hearing sphere and the excision of the right lower lemniscus from the bigemina posteriora in the region of the exit of the fifth nerve in a cat directly after birth has the following result: Atrophy of the anterior portion of the upper olive

and of its dorsal medullary covering. This atrophy could be traced towards the raphé in a caudal-medial direction, then into the *striæ acusticæ* of the opposite side, and finally into the acoustic tubercle (here in both upper layers); the posterior root and the anterior nucleus of the acoustic nerve did not seem to be materially implicated. The course of one part of the acoustic nerve, therefore, would be, going from the periphery to the centre: Acoustic tubercle (superficial layers); *striæ acusticæ*; crossing in the raphé; inferior lemniscus and dorsal medulla of the upper olive; *corpus geniculatum internum*; hearing sphere. The course of the acoustic nerve is probably on its way to the cerebrum interrupted at least twice by groups of ganglionic cells (*corpora quadrigemina posteriora* and *corpus geniculatum internum*), so that one could speak of primary, secondary, and also of tertiary paths of the acoustic.

8. The course of fibres in the central nervous system of the lower vertebrates is almost as much complicated as in man, consequently their examination does not cast much light upon their relations. Pictures which are almost ideally transparent are obtained by combining the study of the development of the medullary sheaths with that of the central nervous system of lower vertebrates. Young slow-worms (*anguis fragilis*), about twenty days old, are well fitted for these examinations. We can easily distinguish therefrom, that fibres descend from both sides of the intermediary brain into the medulla oblongata, turning now here now there inwards, transgressing the raphé, and collecting outward of the crossed posterior longitudinal bundle to a funiculus, which is larger at the fifth nerve, but thinner at the eighth, ninth, and tenth. But each of the nuclei receives a separate tract. The author suggests to call this tract, as being identical with a part of the lemniscus in man, the "central sensory course." The nuclei of the sensory course would be connected in the same manner as the nuclei of the posterior columns by *fibræ arcuatæ* with higher located centres of the crossed side.

9. BECHTEREW refers to his examinations,¹ and does not agree with EDINGER, that the anterior root of the acoustic nerve arises from the so-called inner nucleus of the acoustic. He desires to have the posterior portion of the "direct sensory cerebellar path" still acknowledged as the ascending root of the acoustic. Also against EDINGER stands the fact that there is no direct connec-

¹ Cp. THESE ARCHIVES, vol. xv., Nos. 2 and 3, p. 252.

tion between the roots of the peripheral nerves and the cerebellum. The so-called ascending root of the acoustic is undoubtedly a continuation of the second branch of the anterior root, but not a continuation of the posterior columns to the cerebellum. The second part of the paper criticizes the researches of BAGINSKY, who explains the motory disturbances following lesions of the semicircular canals by simultaneous injuries to the cerebellum.

b.—NASO-PHARYNGEAL CAVITY.

1. ROSTANECKI, CASIMIR VON. The pharyngeal ostium of the Eustachian tube and its relation to the naso-pharyngeal cavity. With two plates. (From the Anat. Inst. at Berlin.) *Arch. f. mikros. Anat.*, vol. xxix., p. 539. Reprint.

2. ZUCKERKANDL, E. On the centre of smell. A comparative anatomical study. (Stuttgart, 1887, Enke.) From a review by S. Freud in the *Monatsschr. f. Ohrenheilk.*, etc., 1887, p. 132.

1. ROSTANECKI, after reviewing the existing literature and comparing it carefully with his own thorough investigations, gives, in a measure, a monograph on the pharyngeal ostium of the Eustachian tube and the naso-pharyngeal cavity. He explains with skill some abnormal cases, and thus simplifies their comprehension. It would serve no purpose to review here portions of the paper, as it is necessary to look at the drawings in order to understand the complicated and varied relations, and it is often desirable to inspect the specimens. We refer herewith urgently to the original. We draw the attention of the physicians to the particular point observed by Rostanecki against other modern authors—that the pharyngeal tonsil may extend to the tuberosity of the tube, and even into its ostium.

2. The olfactory nerve in a number of mammals shows a striking tendency to a retrogressive state. The parts of the cerebrum partaking in this retrogression must thereby be considered as belonging to the "centre of smell." The parts of the cerebrum having the relations to the olfactory in the manner mentioned, are the portions of the medial surface which form the inner margin of the primitive cerebral vesicle, hence surround the fornix, which they perforate later, and complete the ring by joining the olfactory tract and its roots—in man the region of the gyrus forniciatus and the parts situated underneath. The frontal extremities of the lobus corporis callosi and of the lobus hippocampi in the "anosmatic" animals are atrophic; the atrophy of the latter is extremely devel-

oped in dolphins, in which the olfactory nerve is entirely absent. Inwardly from the gyrus fornicatus the lobus limbicus in animals is a small marginal tract, called by ZUCKERKANDL the gyrus marginalis, which is stinted in man to the greatest extent. The anterior commissure seems also to belong to the olfactory region of the cerebrum. MEYNERT described the anterior commissure as a chiasma of the olfactory nerve. FREUD considers this a part of the centre of smell, as the olfactory tract is seen in the human embryo to come out of the anterior portions of the fissures of SYLVIUS.

II.—PHYSIOLOGY AND PHYSICS OF THE HEARING ORGANS.

1. DELAGE, M. YVES. Sur une fonction nouvelle des otocystes chez les invertébrés. *Compt. rend.*, vol. ciii., p. 798.
2. VIGUIER, M. C. Sur les fonctions des canaux sémicirculaires. (Extrait.) *Ibid.*, vol. civ., p. 686.
3. Prof. W. RUTHERFORD, F.R.S. A new theory of hearing. *Journ. of Anat. and Physiol.*, vol. xxi., p. 166.
4. KOENIG, A. On the testing of acuteness of hearing by sounding-out tuning-forks. *Verh. d. physiol. Gesellsch.*, 1887, Nos. 11 and 12.
5. Dr. H. DENNERT (Berlin). Acoustic physiological examinations with demonstrations. (Lecture delivered September 22, 1886, in the otological section of the meeting of naturalists in Berlin.) *Arch. f. Ohrenheilk.*, vol. xxiv., p. 171.
6. Dr. W. KIESSELBACH. On tinnitus aurium. *Sitzungsberichte d. physic-med. Societät in Erlangen*, No. 18, p. 95.
7. F. MELDE (Marburg). Acoustic investigations. Third series. *Wiedemann's Annalen d. Physik und Chemie*, vol. xxx., No. 1, p. 161.
8. MERCADIER, M. E. Sur la théorie du téléphone : monothéâtre ou résonateur électromagnétique, Presented by M. Corum. *Compt. rend.*, vol. civ., p. 970.
9. MERCADIER, E. On two new kinds of radiophone. *Journ. d. Phys.*, 1886 (second series), vol. v., p. 215. (From a review in the *Naturwiss. Rundschau*, 1885, p. 327.)
10. Dr. NOWITZKY (Kasan). On the physiological qualities of the fibres of the chorda tympani in man. (From the aural department of the military hospital at Kasan.) *Medizinskoje obosrenije*, 1886, No. 11, June 15.

1. The author has experimented with mollusks and higher crustacea. If the eyes are destroyed, the movements are retarded in most cases, but otherwise hardly disturbed ; but after an injury to the otocysts the most marked disturbances of movement develop, especially when the animals attempt to get up. Hence he infers that the otocysts have the same physiological significance as the labyrinth in higher animals.

2. A short communication against YVES DELAGE referring to VIGUIER's paper, which has treated the same subject in the *Revue philosophique* and in the *Revue internationale des sciences*, 1882.

3. The author compares the process of hearing in the ear with the telephone, and would like, therefore, to call his theory the "telephone theory." He supposes that the little hairs of all cells of the cochlea follow the vibrations of the memb. tymp., which are transmitted by means of the cells through the nerves to the brain. It is here, the first time, that the mechanical, *i. e.* in a certain sense the electrical, irritation is changed into the specific sensation ; here the perceived impressions are first dissolved into isolated tones, harmonies, and discords.

5. The author has promised to publish the tenor of the lecture in these ARCHIVES, with the addition of new facts. The principal features of this paper are as follows : 1. If we call the time, during which a tuning-fork after being struck can still be heard by a normal ear by bone- or by air-conduction, the sounding-time of the bone- or the air-conduction, then we may characterize the pathologically increased or lowered amount of the lower irritation threshold of an ear, by expressing the sounding-time of this ear in the unit of the normal sounding-time. 2. In tuning-forks of the same pitch and of the same initial amplitude, this determination is independent of the logarithmical decrement of the vibrations of the tuning-fork.

6. KIESSELBACH asserts that in healthy and sick persons the sound perceived in tinnitus and the ringing produced by the galvanic current is an objective sound. The sound produced by the circulation of the blood is to be regarded as source of the noise ; we do not hear it under normal conditions, because we are accustomed to the sensation, but we perceive it as soon as the objective noise has increased or changed, or the sensitiveness of the acoustic nerve is intensified. The invariable perception of a certain sound is explained by the resonance of the tympanic cavities. The doctrine of the specific energy is to be confined to the follow-

ing limits : An irritation of the acoustic nerve, in the specific sense, is effected only by repeated influences of vibrations of a certain nature, transferred from the outside to the sound-perceiving apparatus. All other influences are said only to increase the irritability. Possibly this view may not wholly agree with the physiological facts.—REV.

7. Although the researches were of a purely physical nature, I deem it advisable to mention them, because they permit several conclusions as to the vibratory processes in the membr. *tymp.* and in the internal ear. We deal with vibrations of rotatory planes, namely, of bells, circular cylinders, and funnels. Further researches are related, where a body that is susceptible of vibratory motions is inserted into another, and are demonstrated, under what circumstances one causes the other to follow the vibrations or to deaden them. For further details, see the original.

8. The telephonic tympanum may vibrate in two ways : either that it vibrates mainly transversely, namely, in its own key, by supporting it in a given way ("monotelephon" or "electro-magnetic resounder"), or so that it reflects the vibrations of sound with the utmost possible accuracy ("Pantelephon"). The monotelephone can be easily changed into a pantelephone by deadening the vibrations of its own key.

9. There are two methods of producing impressions of hearing by intermittent radiation ; the conversion of rays into sound is either direct or indirect. We distinguish three separate kinds of direct transmission—thermophones, photophones, and aktinophones. Up to the present, no example of the last is known. The indirect radiophones convert the energy of radiation into energy of sound by intermediary transformations. BELL's apparatus is the only one which has been heretofore known as such, and which has derived from its action the more accurate name, photoelectrophone. MERCADIER has constructed two new kinds of indirect radiophones, the principle of which is based upon the conversion of the energy of the rays of heat. As auxiliary apparatus, the telephone and the mikrophone are used. The pitch of the notes depends upon the interruptions of radiation. According to its action, one is called "Thermoelectrophone" and the other "Thermomagnetophone."

10. The author has examined whether the *chorda tympani* contains all gustatory nerves for the anterior two-thirds of the tongue, or whether a part of them is supplied by the *nervus lingualis* tri-

gemini ; furthermore, whether the chorda contains fibres for sensations of taste and pain. He arrived at the latter question, because in pathological cases irritation (with the probe, syringe, and brush—URBANTSCHITSCH, TRÖLTSCH) produced only in exceptional cases specific sensation of taste, but with far more regularity, pain, tickling, and burning. The material for his examinations consisted of two cases of otitis externa (et media) gangrænosa dextra in two soldiers, probably caused by attempts at self-mutilation. Both had facial paralysis of the right side, the velum palati not being involved. The soldiers were subjected to the examinations mentioned above, and also the secretory functions of the chorda in the sublingual and submaxillary glands were tested to make the examinations complete. The researches were made with all the necessary precautions, and in sufficient number, as can be seen from the original. As regards the function of taste, e. g., each of the four gustatory fluids (concentrated solution of salt, solut. chinin. muriat., 1.3 : 30.0, syrup with aqua $\ddot{a}\ddot{a}$, acid tartar., 2.0 : 30.0) were tried sixty times on each patient, and counterexperiments were made with aqua destill.; at the time being only two kinds of taste, and that only on two places of the tongue, were tested.

The results of the examination on the alteration of taste are as follows : The anterior two-thirds of the back of the tongue were on both sides insensitive to all four impressions of taste as mentioned ; at the point and at the lateral margins of the anterior two-thirds, each fluid was exactly perceived on the left side, but the solutions of salt and quinine more slowly than the two others. On the right side entire absence of any kind of sensation of taste was noticed ; at the base of the tongue all four fluids were accurately distinguished.

He concludes : There are people, whose chorda contains three kinds of fibres : gustatory, sensory, and secretory.

B.—PATHOLOGY AND THERAPEUTICS.

By A. HARTMANN, BERLIN, AND ED. SCHULTE, MILAN.

Translated by Dr. MAX TOEPLITZ, New York.

I.—GENERAL LITERATURE.

1. Prof. DE ROSSI. *Saggi di clinica chirurgica otojatrica, laryngojatrica, rinojatrica. Anno scolastico, 1885, 1886.* Rome, 1887.

2. KIPP, C. J., and RANKIN, WM. Seventh annual report of the Newark Charitable Eye and Ear Infirmary, 1887.
3. MATHEWSON, PROUT, and RUSHMORE. Brooklyn Eye and Ear Infirmary. Report for 1886.
4. MACKAY. Report of cases of diseases of the ear under the care of Dr. KIRK DUNKANSON. *Edinburgh Med. Four.*, Feb., 1887.
5. BACON, GORHAM. A report of twenty-one cases of traumatic lesion of the ear. *N. Y. Med. Four.*, May 7, 1887.
6. SEXTON, SAMUEL. Boxing the ears. *Med. Record*, June 11, 1887.
7. SEXTON, SAMUEL. Injury of the ear caused by the blast of a bursting shell, with some remarks on the effects of explosives on the organ of hearing in warfare. *Med. Record*, Feb. 19, 1887.
8. EITELBERG, A., Vienna. Contribution to the differential diagnosis of the diseases of the sound-conducting and sound-perceiving apparatus. *Wiener med. Presse*, 1887, Nos. 10-12.
9. KRETSCHMANN, F. On carcinoma of the temporal bone. *Arch. f. Ohrenh.*, vol. xxiv., 4.
10. LICHTWITZ. Les anesthésies hystériques des muqueuses et des organes des sens et les zones hystérogiènes des muqueuses. Paris, 1887.
1. DE ROSSI's full report embraces a large number of valuable experience in otology, rhinology, and laryngology. In acute inflammations of the middle ear Rossi added to myringotomy an immediate inflation of boric acid, preventing thereby suppuration and effecting a quick cure. Caustic treatment of purulent otitis media with strong solutions of nitrate of silver was given up on account of the pain that it caused and the extension of inflammation to the mastoid process, which sometimes followed. Treatment with boric acid was substituted for it. When retention of secretion is feared from the application of boric acid, boro-glycerine is recommended, which has been found very successful by the author. Sclerosing processes were treated in the usual manner. The bases of polypi were destroyed with the galvano-cautery. Alcohol did not produce any visible effect upon the remains of the polypi. In diseases of the acoustic nerve Rossi obtained excellent results in several cases with injections of pilocarpine. Four hundred and ninety-six patients were treated in one year, 1885-6. The second part of the report deals with the "clinica laryngo-rinojatrica."

S.

gemini ; furthermore, whether the chorda contains fibres for sensations of taste and pain. He arrived at the latter question, because in pathological cases irritation (with the probe, syringe, and brush—URBANTSCHITSCH, TRÖLTSCH) produced only in exceptional cases specific sensation of taste, but with far more regularity, pain, tickling, and burning. The material for his examinations consisted of two cases of otitis externa (et media) gangrænosa dextra in two soldiers, probably caused by attempts at self-mutilation. Both had facial paralysis of the right side, the velum palati not being involved. The soldiers were subjected to the examinations mentioned above, and also the secretory functions of the chorda in the sublingual and submaxillary glands were tested to make the examinations complete. The researches were made with all the necessary precautions, and in sufficient number, as can be seen from the original. As regards the function of taste, e. g., each of the four gustatory fluids (concentrated solution of salt, solut. chinin. muriat., 1.3 : 30.0, syrup with aqua $\ddot{a}a$, acid tartar., 2.0 : 30.0) were tried sixty times on each patient, and counterexperiments were made with aqua destill.; at the time being only two kinds of taste, and that only on two places of the tongue, were tested.

The results of the examination on the alteration of taste are as follows : The anterior two-thirds of the back of the tongue were on both sides insensitive to all four impressions of taste as mentioned ; at the point and at the lateral margins of the anterior two-thirds, each fluid was exactly perceived on the left side, but the solutions of salt and quinine more slowly than the two others. On the right side entire absence of any kind of sensation of taste was noticed ; at the base of the tongue all four fluids were accurately distinguished.

He concludes : There are people, whose chorda contains three kinds of fibres : gustatory, sensory, and secretory.

B.—PATHOLOGY AND THERAPEUTICS.

By A. HARTMANN, BERLIN, AND ED. SCHULTE, MILAN.

Translated by Dr. MAX TOEPLITZ, New York.

I.—GENERAL LITERATURE.

1. Prof. DE ROSSI. *Saggi di clinica chirurgica otojatrica, laryngojatrica, rinojatrica. Anno scolastico, 1885, 1886.* Rome, 1887.

2. KIPP, C. J., and RANKIN, WM. Seventh annual report of the Newark Charitable Eye and Ear Infirmary, 1887.
3. MATHEWSON, PROUT, and RUSHMORE. Brooklyn Eye and Ear Infirmary. Report for 1886.
4. MACKAY. Report of cases of diseases of the ear under the care of Dr. KIRK DUNKANSON. *Edinburgh Med. Jour.*, Feb., 1887.
5. BACON, GORHAM. A report of twenty-one cases of traumatic lesion of the ear. *N. Y. Med. Jour.*, May 7, 1887.
6. SEXTON, SAMUEL. Boxing the ears. *Med. Record*, June 11, 1887.
7. SEXTON, SAMUEL. Injury of the ear caused by the blast of a bursting shell, with some remarks on the effects of explosives on the organ of hearing in warfare. *Med. Record*, Feb. 19, 1887.
8. EITELBERG, A., Vienna. Contribution to the differential diagnosis of the diseases of the sound-conducting and sound-perceiving apparatus. *Wiener med. Presse*, 1887, Nos. 10-12.
9. KRETZSCHMANN, F. On carcinoma of the temporal bone. *Arch. f. Ohrenh.*, vol. xxiv., 4.
10. LICHTWITZ. *Les anesthésies hystériques des muqueuses et des organes des sens et les zones hystérogènes des muqueuses*. Paris, 1887.
11. DE ROSSI's full report embraces a large number of valuable experience in otology, rhinology, and laryngology. In acute inflammations of the middle ear Rossi added to myringotomy an immediate inflation of boric acid, preventing thereby suppuration and effecting a quick cure. Caustic treatment of purulent otitis media with strong solutions of nitrate of silver was given up on account of the pain that it caused and the extension of inflammation to the mastoid process, which sometimes followed. Treatment with boric acid was substituted for it. When retention of secretion is feared from the application of boric acid, boro-glycerine is recommended, which has been found very successful by the author. Sclerosing processes were treated in the usual manner. The bases of polypi were destroyed with the galvano-cautery. Alcohol did not produce any visible effect upon the remains of the polypi. In diseases of the acoustic nerve Rossi obtained excellent results in several cases with injections of pilocarpine. Four hundred and ninety-six patients were treated in one year, 1885-6. The second part of the report deals with the "clinica laryngo-rinojatica." S.

2. In the Newark Eye and Ear Infirmary there were treated, in 1886, 1092 ear cases. Of these 56 were of the auricle, 269 of the external auditory canal, 746 of the middle ear, 6 of the inner ear, and 11 unclassified. Of operations, the most important were: paracentesis of the drum-head, 27; section for mastoid abscess, 5; perforation of mastoid cells, 1; removal of necrosed bone from mastoid, 1; polypus from ear, 11.

SWAN M. BURNETT.

3. The ear cases in the Brooklyn Eye and Ear Hospital for 1886 were 1,603 in number. Of the important operations there were of Wilde's incision, 5; polypi, 6; paracentesis of *Mt*, 4.

S. M. B.

4. MACKAY's report embraces 3,725 ear patients treated during four and a half years in Kirk Dunkanson's Infirmary. 33% of all cases were chronic purulent inflammations of the middle ear; 27.8% were chronic catarrhal affections, of which 5% were of syphilitic nature. Mackay also, like Richey and many others, considers ceruminal plugs as indications of a more serious disease of the middle ear.

S.

5. BACON gives more or less full notes of all the cases. Among the important facts to be noted are that in six cases the inflammation of the external canal was caused by the introduction of hairpins. Injuries in other cases were caused by pins, sticks, ear-scoops, etc. The drum-head was ruptured by a fall in one case, by a blow in one, and by the loud report of a cannon in one. Snow-balls were the causes of injury in two cases. The author is inclined to the belief that in most cases of traumatic rupture of the *Mt* from rarefied or condensed air, the drum-head was weakened through a catarrhal process or a calcareous deposit. The medico-legal aspects of such cases are noted.

S. M. B.

6. SEXTON treats rather extensively of the effect of the too common practice of boxing the ears. The symptoms are nervous shock, pain, deafness, autophony, and numbness, and where there has been a rupture of the *Mt*, the characteristic whistle. The rupture may be single or multiple. The prognosis is, in most instances, favorable. As a point in diagnosis, he thinks that ruptures of the *Mt* from blows are usually on the membrana vibrans, while those from pulling are in the membr. flaccida. As regards treatment, the *laissez-faire* plan is recommended. He suggests, however, in some cases insufflation of boric acid and calendula. The medico-legal aspects of the injury are also considered.

S. M. B.

7. SEXTON gives in this paper, which is very exhaustive in details, the results of an examination of the ears of eight men, who were in the vicinity of an exploding shell. In six of the men there was rupture, in some of them extensive, of the drum-head. In all there was serious impairment of hearing. S. M. B.

8. EITELBERG argues from the supposition that a diseased acoustic nerve tires more readily than a normal one. He sounded a tuning-fork for fifteen to twenty-five minutes in front of the ear, by striking it with the same force each time by means of a certain contrivance. The duration of perception was recorded each time. Experiments were made upon persons with normal hearing and upon fifty patients. In persons with normal hearing the duration of perception after a slight diminution increased so much that it was greater at the termination than at the beginning of the experiment. In affections of the conducting apparatus the same result was obtained, if the duration of perception was greater from the start; if this was not the case, it remained about the same during the entire examination. If, on the other hand, the duration of perception was considerable from the beginning, it remained about stationary, only in affections of the labyrinth. It generally decreased in the latter without rising again to the initial amount.

9. KRETZSCHMANN undertook to depict the clinical and anatomical features of the carcinomata of the temporal bone upon the basis of four cases observed by himself, and twelve cases collected from literature. As regards the etiology, he arrived at the incontrovertible conclusion that a large number of neoplasms develop on the soil of chronic suppuration. As another etiological factor, he emphasizes the habit of many persons of boring in the ear with an instrument. The differential diagnosis between carcinomata and sarcomata is made by the quicker growth of the latter, by the tumor developing in the surroundings of the ear, by the more rapid course taken by the sarcomata, and by the prevalence in children at the ages of the first decennium. As regards treatment, the author pleads for the removal of all masses within reach with the sharp spoon, since thorough removal of the putrid masses makes the state of the patient much more tolerable, even if the duration of life is thereby shortened. Regarding the anatomical and histological details, we refer to the corresponding part of this report. S.

10. LICHTWITZ, in his elaborate monograph, describes the

hysterical anæsthesia of the mucous membranes, and of the organs of sense, upon the basis of numerous personal observations and considerable experience, with careful reference to the literature existing on this subject. We must confine ourselves to the recommendation of the paper to the study of our readers, and to quote only the conclusions referring to the hearing organ. The hearing organ and the membrana tympani were twice anæsthetic on the hemianæsthetic side of the body. In the other cases of hemianæsthesia of the dermal surface, only the cartilaginous part of the external auditory canal was insensitive, whilst the osseous part and the *Mt* remained sensitive. In analgesia of the skin, the external canal and the *Mt* were also analgesic. The Eustachian tube never seemed to be anæsthetic. In these cases complete, or almost complete, deafness was noticed on one side. In two other cases only the perception of whisper was decreased, the air-conduction for the watch and the crano-tympanic perception being normal. In the sixth patient the hearing was decreased only for the tick of the watch when heard through the air. In two cases there was deafness for very high notes. The crano-tympanic conduction was completely destroyed in one ear only in cases of complete deafness on one side. It was decreased or unchanged when this was the case with the air-conduction. The different tuning-forks placed upon the vertex were perceived better or only by the normal ear in cases with impairment or anæsthesia of hearing on one side. Rinne's experiment showed always a positive result. There did not exist any relations between the anæsthesia of hearing and that of the skin. No connection was found between the partial and general anæsthesia of the hearing organ. There was no hearing in one ear, of which the external canal and the membrana tympani were sensitive, whilst it was preserved in another, of which these parts were anæsthetic.

II.—INSTRUMENTS AND METHODS OF EXAMINATION.

11. PRINCE, ARTHUR E. The Politzometer; an instrument to increase facility and precision in the inflation of the middle ear. *Medical News*, 1887, No. 23.

12. SEISS, RALPH W. A new method of treating chronic aural catarrh. *Medical News*, 1887, No. 6.

13. MITCHELL, H. E. A modification of Politzer's air-bag. *Transact. N. Y. State Med. Association* for the year 1886-1887, p. 207.

14. BISHOP, S. S. Novel methods of treating diseases of the middle ear. *Journ. Amer. Med Assoc.*, June 15, 1887.

15. Dr. KRAUSE, instruments devised by. *Monatsschr. f. Ohrenheilk.*, etc., 1887, No. 3.

16. KILLIAN, GUSTAV. A new galvano-caustic immersion battery. *Deutsch. med. Wochenschr.*, 1887, No. 15.

11. PRINCE, as a substitute for the swallowing, the "hick, heck, hock," and other means of closing the pharynx during inflation by POLITZER's method, uses a tube attached to a column of mercury, through which the patient blows. The velum hereby closes the naso-pharyngeal cavity, and the muscles of the tube open its entrance. Prince considers this method to be less unpleasant to the patient, more convenient to the physician, and more valuable for diagnosis and prognosis. The amount of displacement of the mercury registered the amount of pressure required to dilate the tubes and inflate the tympanum. The author calls the instrument "*Politzometer*." SWAN M. BURNETT.

12. The new method of SEISS consists in medicating the mouth of the *Eustachian* tube by means of a catheter perforated at its sides near the point. The medicament is thrown into the catheter by means of a syringe. Seiss and C. H. BURNETT have seen the best results from the use of this instrument, by which they have applied for the last year various antiseptics and astringents.

SWAN M. BURNETT.

13. MITCHELL's modification of POLITZER's air-bag consists of an instrument with a smaller bulb and an automatic valve, whereby the air can be forced from it much more quickly, and the expense is reduced to a minimum. M. TOEPLITZ.

14. The novel methods of BISHOP are perhaps in use by many otologists. The first one consists in exhausting the drum cavity and bringing away its fluid contents by reversing the Valsalva experiment. The second is to accomplish the same end by introducing the catheter and making suction by means of a syringe. The third, which the reviewer has used for many years, consists in filling the meatus with the desired liquid in cases where the *Mt* is gone or perforated, then sucking the air out by means of the reversed VALSALVA, when the liquid will pass down the tube into the throat. SWAN M. BURNETT.

15. KRAUSE describes a fixable palate-hook, a curved trocar for opening HIGHMORE's antrum, a trocar à double courant, and a nasal saw, and gives illustrations of them. S.

16. KILLIAN'S immersion battery, consisting of zinc-carbon plates immersed in chromic-acid solution, is worked by simply placing the foot upon a treadle. The glowing is increased by treading more downward, but ceases when the foot is removed. The author considers his instrument to be of especial advantage, inasmuch as the battery is much preserved by the manner in which it is immersed and by its automatic elevation immediately after the cauterization is finished.¹ S.

III.—EXTERNAL EAR.

17. Dr. W. KIRCHNER, Würzburg. Contribution to the etiology of furuncle. *Monatsschr. f. Ohrenheilk.*, etc., 1887, No. 1.

18. STEINHOFF, FRANZ. Observations upon otitis externa crouposa. *Inaug. Dissert.*, Leipzig, 1886.

19. Dr. I. PURJESZ, Budapest. Formation of a bridge of connective tissue in the external ear. *Wien. med. Wochenschr.*, 1887, No. 1.

20. FIELD, GEORGE P. On aural exostosis. *Brit. Med. Four.*, 1887, No. 1374.

21. STORY, JOHN B. Oxostosis in the auditory meatus. *The Dublin Journal of Medical Science*, January, 1887.

22. JAKINS, PERCY. A case of ear cough. *The Practitioner*, June, 1887.

23. Dr. ZIEM, Dantzig. An amber button in the ear. *Monatsschr. f. Ohrenheilk.*, etc., 1887, No. 5.

24. Dr. CHARLES DELSTANCHE, Brussels. "Observations de corps étrangers dans l'oreille. *Annales des maladies de l'oreille*, etc., 1887, No. 2.

25. GURANOWSKI, Warsaw. Contribution to myringoplasty by means of the shell-skin of a hen's egg. *Medycyna*, 1887, Nos. 12, 13, 14.

26. WAGNIER, Lille. Du tympan artificiel. *Revue mens. de laryng.*, etc., 1887, No. 6.

27. HUMMEL. The measurement of the capacity of the external auditory meatus under normal and pathological conditions. *Arch. f. Ohrenheilk.*, vol. xxiv., 4.

17. KIRCHNER succeeded in obtaining from the contents of

¹ An analogous instrument has been devised by SEILER, and known for a long time in this country (M. T.).

aural furuncles pure cultures of *staphylococcus pyogenes* on sterilized gelatine. Hence he concludes that the treatment of furuncles, in addition to the incision, must be antiparasitic, and recommends to syringe the meatus with a lukewarm one per cent. solution of sublimate previous to the opening, to dry it with sublimate cotton, and to brush the sublimate solution into the wound by means of a camel's-hair brush after the incision. The author reports, in addition, a case of direct transmission of an aural furuncle from one individual to another by means of a sponge used for cleansing an ear affected by furunculosis. S.

18. STEINHOFF, upon the basis of thirty-five histories of cases of otitis externa crouposa from BEZOLD's practice, describes the symptoms as follows: In addition to another affection of the ear (diseases of the external ear 19 times, inflammation of the middle ear 11 times), or to spontaneous occurrence (5 times), there existed pulsating pain, considerable diminution of hearing and fulness in the ear, in connection with the formation of fibrinous exudation, which appeared once or twice upon the surface of the membrana tympani, or the walls of the external meatus. The pseudo-membranes are easily removed with syringe or forceps. They are whitish-yellow, partially suffused with blood, and "their gelatinous consistency and the resistance which they offer the needle when teased are so characteristic, that from this condition alone the diagnosis can be made with certainty. The microscopical examination of the removed membranes always showed "a delicate, fine, and at times somewhat grosser network, with often more or less incarcerated, laminated epidermis cells and round cells, which, however, are not equally distributed over the entire specimen." The prognosis is favorable. The treatment consists in the removal of the membranes, drying of the external meatus, and subsequent inflation of powdered boric acid or iodoform.

19. In PURJESZ's patient, who suffered from otorrhœa for twelve years, an intense swelling of the external meatus developed, which, after its subsidence, left two opposite granulations in contact. A firm bridge of connective tissue arose from these. This was cut and the cut surfaces cauterized with nitrate of silver. A similar case with a membrane of connective tissue already formed was observed and treated in the same manner. Purjesz found only two cases of the same kind in literature.

20. FIELD published in the *British Medical Journal* for 1886, sixteen cases of exostoses of the external auditory meatus, and

continues here with nine more cases of the same kind, in which the lesion existed on one or both sides. Seven of these were operated with drills similar to those used by dentists. To avoid too deep a penetration of the drill a crossbar is attached to the handle. The instruments used are illustrated. One female patient was operated upon with a forceps; on another the operation was considered superfluous, and not performed. Field deems the operation unnecessary if the exostosis does not cause any disturbance or danger, but he considers it urgently indicated if it prevents a discharge of pus.

21. STORY had under treatment a case of exostosis in both external canals. They were situated close to the drum-membranes. The acuteness of hearing was greatly diminished. Story first thoroughly cauterized the skin covering the tumor in the right ear with carbolic acid, then bored a hole into the exostosis with the dental drill, and placed into the hole a negative electrode for the purpose of electrolysis. Several electrical sittings of three minutes' duration took place. Between times cauterizations with potash, lime, and Vienna paste were made. By means of the latter a perforation of the membrana tympani, which soon again healed, was produced, but the hearing improved remarkably and permanently.

The left ear was not operated upon. The author is of the opinion that exostoses of the external meatus should not be operated upon if they do not cause any defect in the hearing, and even not if they destroy the faculty of hearing in only one ear whilst the other retains its hearing power.

22. JAKINS treated a patient who had suffered for four years from a steadily increasing cough, and since that time had been hard of hearing. Finally he grew thin, night sweats set in, and at times he was delirious and could not sleep at night. Jakins found mucous râles in the lungs and plugs in the ear. After removal of the latter the patient slept already the following night, the pulmonary symptoms disappeared, his weight increased, and he was fully capable of following his occupation after three months.¹

23. ZIEM removed from the external meatus of a patient an amber button of polyhedral form, which measured 2.5 mm in its transverse and 6.5 mm in its greatest diameter. Not succeeding

¹ A precisely analogous case was communicated to me a number of years ago by ZELLER, the late chief of the lunatic asylum of Winnenthal.—Moos.

in removing it with the syringe in the erect position, the patient was placed upon the side where the foreign body was located, and this time the operation succeeded. S.

24. DELSTANCHE reported several observations on foreign bodies in the ear, which could not be removed with the syringe in the usual manner, but required treatment with instruments. In the first case a piece of a goose-quill had to be removed with the forceps. The second case was a lady who had placed a piece of turnip in the ear on account of a toothache. By injudicious manipulations it was forced to the bottom, whereupon cerebral symptoms and intense swelling of the external meatus ensued. After two dilatations with laminaria, the foreign body could be removed with the forceps. In the same manner a Swedish match, which was wedged into the drum-membrane, was removed. Out of the lobuli of a child two pieces of an ear-ring were removed after incision. A revolver-bullet, which had entered the external meatus and had lain there without causing any symptoms, was removed after ablation of the auricle, whereupon inflammation of the middle ear set in in consequence of an injury to the membrana tympani, which lasted a long time. Cure, with slight hardness of hearing.

25. GURANOWSKI reports eight cases of otit. med. suppurat. chron., of which three existed on one side, and five on both sides. In three cases the myringoplasty, by means of the shell-skin of a hen's egg, was successfully performed. In five cases the myringoplasty was made seven times, twice successfully, four times with uncertain, and once with unfavorable result. The report is preceded by a short history of myringoplasty.

SREBERNY (Warsaw).

26. WAGNIER gives an historical essay on the artificial drum-membrane. He himself prefers GRUBER's application of the artificial drum-membrane, which consists of a small disk, similar to that of TOYNBEE, but without the guiding wire. Wagnier considers YEARSLEY's small cotton pellet less effective. It should only be employed if Gruber's artificial drum-membrane is not tolerated.

27. HUMMEL, at Bezold's request, has determined the capacity of the normal external meatus, the result of which was 1.07 for the right side and 1.05 for the left. The capacity is the same in 66 per cent., and varies in 44 per cent. On the basis of these results the author attempted to determine the extent of cavities

formed pathologically in the petrous bone. From his comparison of the capacity of the external meatus on the healthy side, with the volume of the external meatus and the cavity on the affected side, and the cubic volume of the cavity, external meatus, is shown that the determination of the external meatus is an important means of ascertaining the extent of the existing processes of destruction in the middle ear.

S.

(To be concluded in our next number.)

REVIEWS.

A Reference Hand-Book of the Medical Sciences.
Edited by ALBERT H. BUCK, M.D. Volumes I. to V. William Wood & Co., N. Y. 1885-1887. (To be completed in eight volumes. Sold by subscription only.)

The articles belonging to otology in the first volume of the "Reference Hand-Book of the Medical Sciences" are: "Auditory Canal," the anatomy of which is by Gorham Bacon; "Its Congenital Defects, Diseases, and Injuries" are treated of by Frank Butler; and "Foreign Bodies in," by Samuel Theobald. "The Diseases of the Auditory Nerve" are considered in a very exhaustive article of fifteen pages, by C. H. Burnett, in which all affections of the auditory nerve and centres, primary and secondary, are treated of in more or less detail. It constitutes an excellent summary of existing knowledge on the subject. "The Anatomy and Physiology of the Auricle" are given by Gorham Bacon, while "Its Diseases and Malformations" receive treatment at the hands of Samuel Sexton.

The otological papers in Vol. II. are most important. "Deaf-Mutes" are treated of extensively by Profs. Gallaudet and Fay, embracing some most valuable statistics, and "Deafness," by H. N. Spencer. "Ear" is treated of under several heads—"The Anatomy of the Labyrinth," by W. G. Thompson; "Ear, Development of," by C. S. Minot, in his customary careful and exhaustive manner; "The Examination of the Ear for Diagnostic Purposes," by Huntington Richards; while "The General Therapeutics of Aural Affections" is attended to by the editor, Dr. Buck. D. B. St. J. Roosa writes of "Non-Suppurative Inflammations of the Typanum," while "The Purulent Inflammations" are treated of in an exhaustive and masterly manner by J. Orne

Green. "The Anatomy and Physiology of the Eustachian Tube" are described by Gorham Bacon.

Vol. III. contains but one paper pertaining to otology, that on "Hearing, Physiology of," by W. G. Thompson.

Vol. IV. contains a paper on "Mastoid Operations," by the editor, an acknowledged authority on the subject; one on "Artificial Membrana Tympani," by C. Hackley; and "Ménières Disease," by W. W. Seeley.

Vol. V. has only one otological paper, that on "Medical Otology," by the editor.

Besides these papers on otology, there are many others, particularly in the domain of general pathology, which the otologist will read with interest and profit. The work is what it claims to be—a reference hand-book of the medical sciences, and contains a great amount of information in a readily accessible form.

S. M. B.

Lehrbuch der Ohrenheilkunde für praktische Aerzte und Studirende. Von Prof. Dr. ADAM POLITZER. Zweite gänzlich umgearbeitete Auflage. Mit 285 in den Text gedruckten Abbildungen. Stuttgart: Verlag von Ferdinand Enke. Preis Mk. 14. (Text-Book of Otology for Practitioners and Students. By Prof. Dr. ADAM POLITZER. Second edition, entirely rewritten. With 285 illustrations printed in the text. Price Mark 14—\$3.50.) Reviewed by A. BARTH, Berlin. Translated by M. TOEPLITZ, New York.

The work in its present shape is more comprehensive and more attractive than before. The numerous additions comprise all the advances otology has made since the appearance of the first edition. The number of illustrations is increased from 125 to 285.

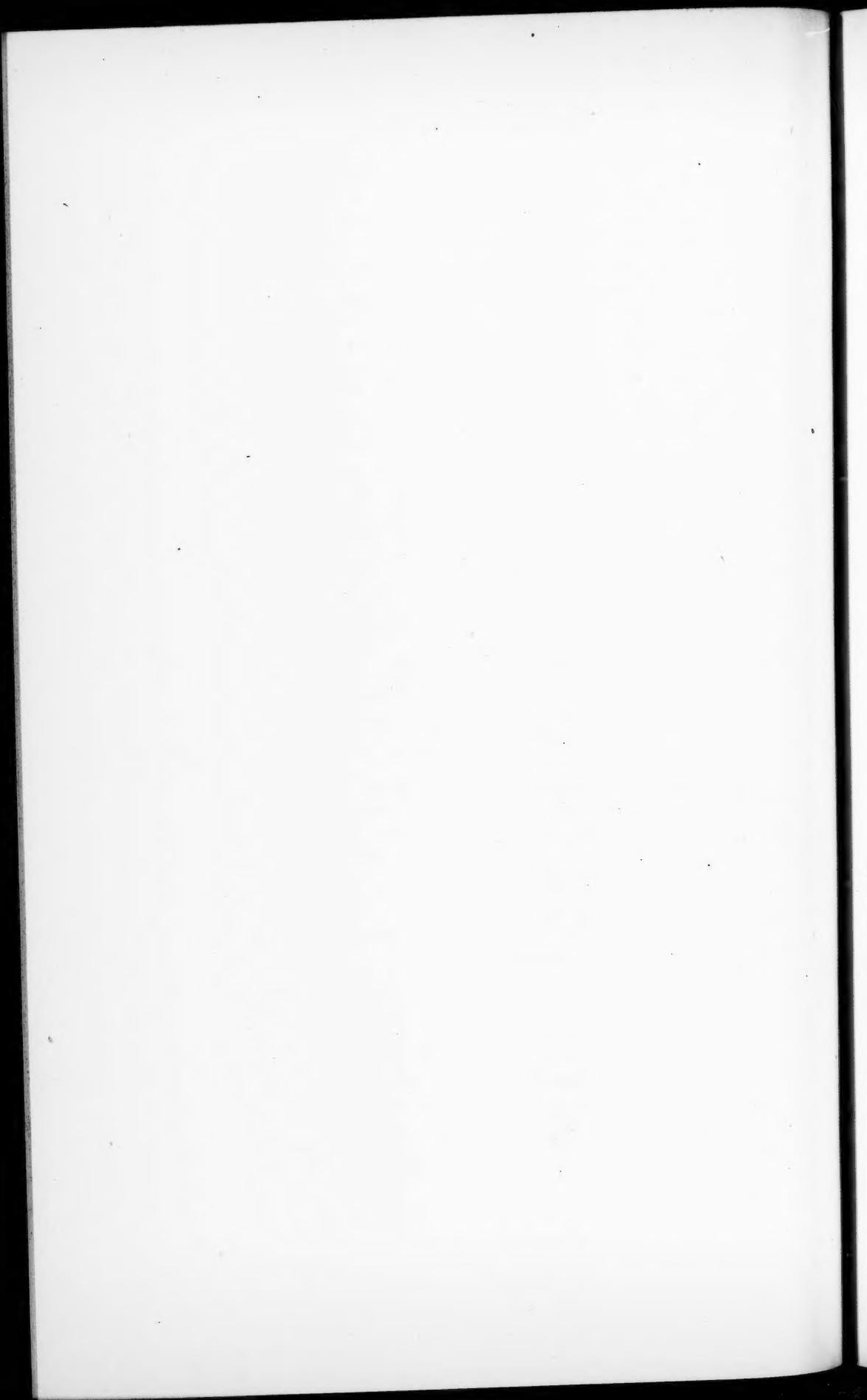
I may be permitted to dwell upon some of the details, in which the new edition differs from the former, or from the opinions of other authors. In contradistinction to the former edition we find that perichondritis does not occur so rarely as it was previously generally supposed. The acceptance of LOEWE's proposition, in the form of a simple note, to remove polypi by means of forced syringing, might not be followed by aurists. The author is, and as I believe correctly, opposed to SCHWARTZ in his plea for the treatment with powdered boric acid in acute and chronic suppuration of the middle ear. He recommends, also, the treatment with alcohol for chronic swelling of the mucous membrane of the middle ear and for small and inaccessible polypi, whilst he would limit the appli-

cation of the so-called caustic method, *i.e.*, the systematic treatment with strong solutions of nitrate of silver. We find on page 441 the sentence: "Combinations of ozæna with diseases of the ear are much rarer than we should suppose from the extension of the process towards the entrance of the Eustach. tube. Where the ear is implicated, the mucous membrane of the middle ear becomes most frequently sclerosed." He permits paracentesis in acute purulent otitis only when a perforation is to be expected from the examination of the drum-head. In simple secretory catarrh of the middle ear, the author is not so reserved in the application of the method. He uses almost exclusively catheters of hard rubber. I deem it necessary to add to the remarks made upon HARTMANN's canula, that this, when used, should not be connected with a simple syringe, but with a rubber ball, provided with a double valve, which sucks the fluid up after each evacuation, without causing any change in the position of the canula. The instrument is applicable only in this form, in which Hartmann has used it for years. As a factor, increasing the subjective sensations of hearing and often simulating peculiar diseases, which is often found in female patients, constipation of the bowels should be inserted at the proper place.

MISCELLANEOUS NEWS.

The Fourth International Otological Congress will be held in Brussels, Belgium, from September 10th to 16th, 1888, immediately after the meeting of the German naturalists and physicians in Cologne, Germany. The names of aurists who will attend and the titles of papers to be read will be received up to May 15, 1888, by the local committee on arrangements:

Dr. CHAS. DELSTANCHE, *President.* Dr. C. GORIS, *Secretary.*



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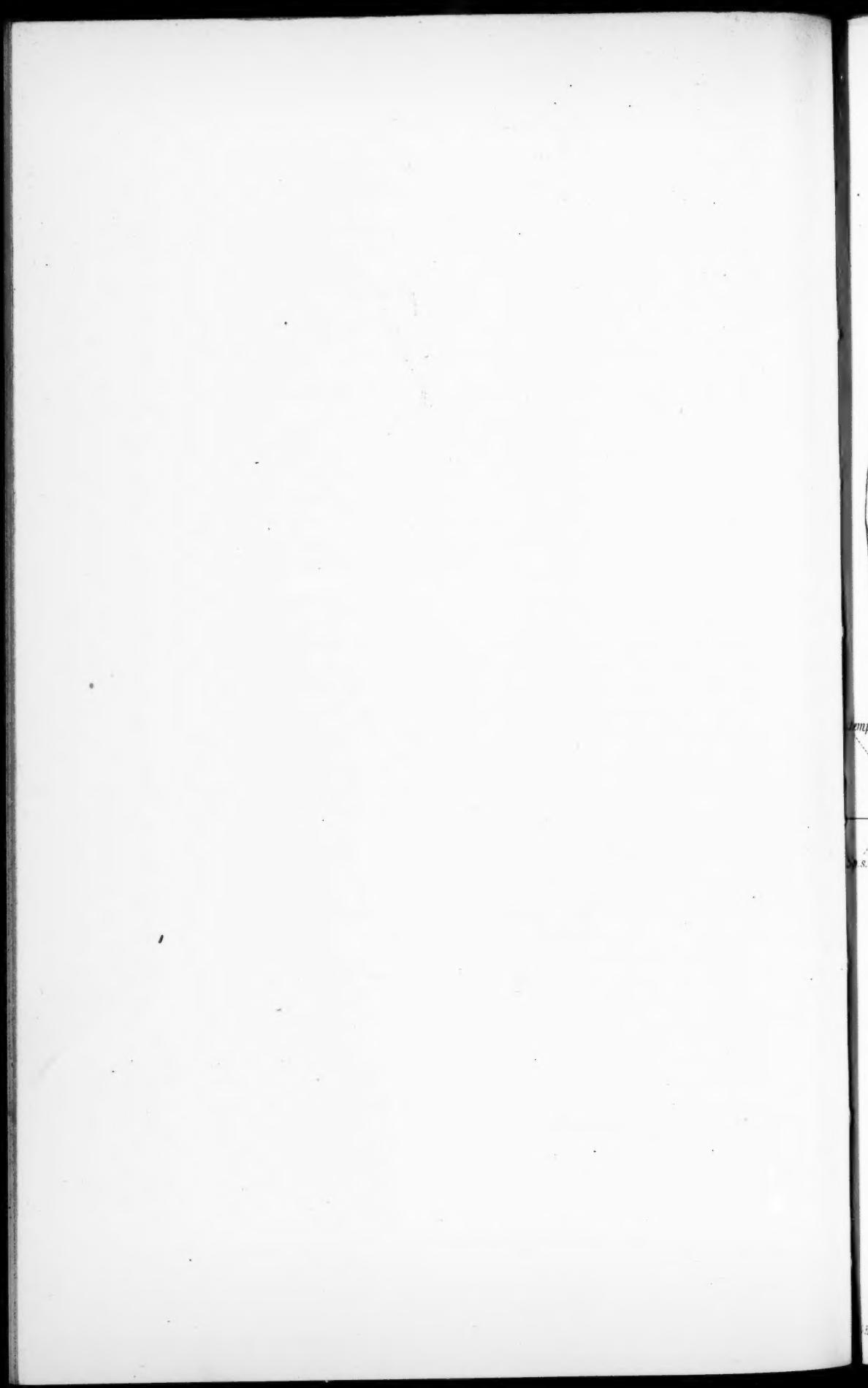
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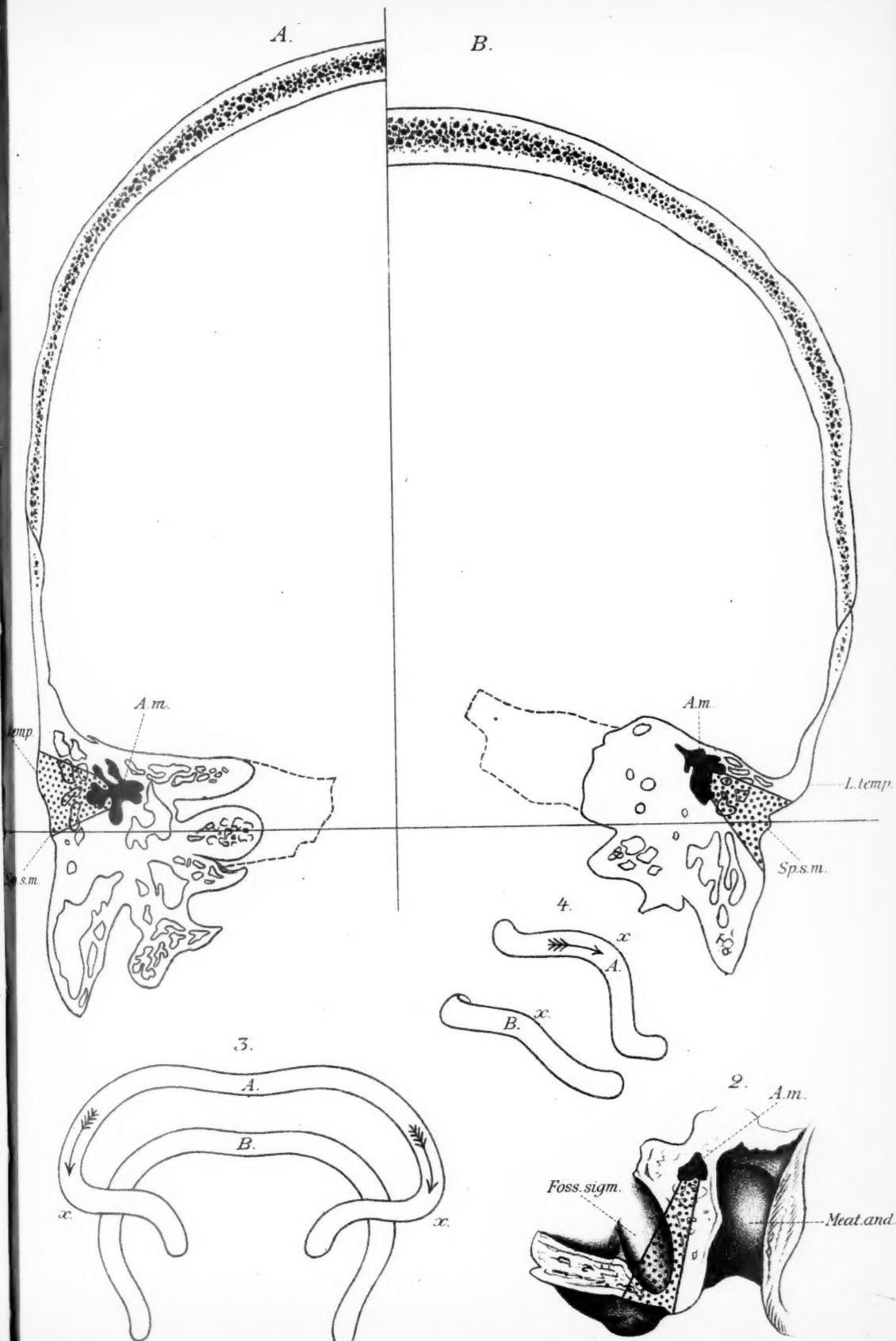
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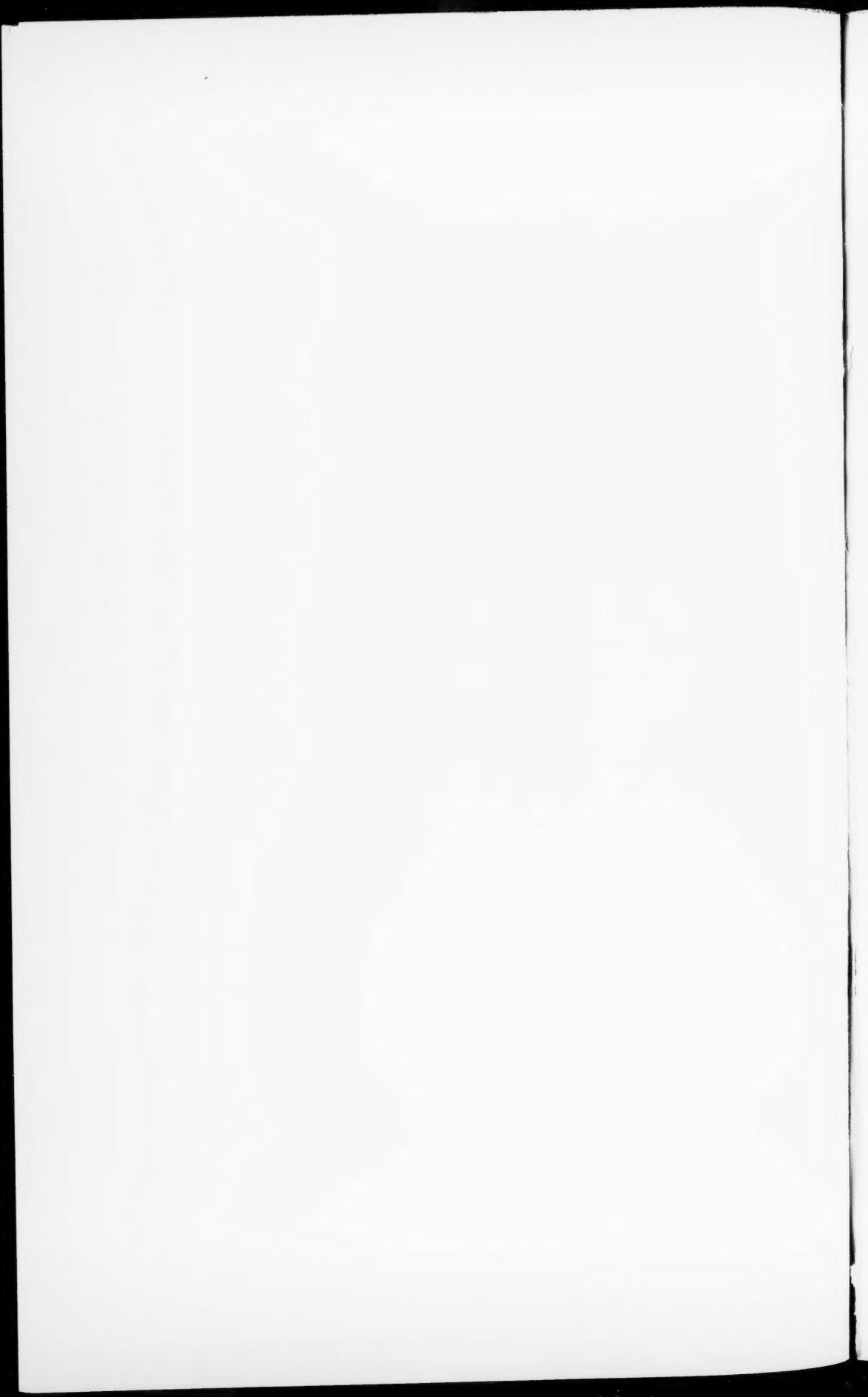




Fig. I



Fig. II



Fig. III



Fig. IV

Labyrinth-nephrose. Facialis paralyse.

Bezold.